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(IRRIGATION)

PAPERS

CONNECTED WITH THE

CAUVERY RESERVOIR PROJECT

VOLUME I

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PAPERS REGARDING THE CAUVERY RESERVOIR PROJECT.

IN THREE VOLUMES.

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PART I.

SPECIAL SUPERINTENDING ENGINEER'S REPORT.

CAUVERY RESERVOIR PROJECT.

PART I.

SPECIAL SUPERINTENDING ENGINEER'S REPORT.

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GAUVERY RESERVOIR PROJECT.

PART I.

Special Superintending Engineer's Report.

SECTION I.

DESCRIPTION OF CAUVERY RIVER AND DELTA WITH THE SYSTEM OF WET CULTIVATION AND ACCOUNT OF PREVIOUS PROPOSALS FOR CONSTRUCTION OF A RESERVOIR.

1. *Description of Tanjore Division.*—The district of Tanjore is about 3,650 square miles in extent and lies between 9° 50′—11° 25′ North Latitude and 78° 55′—79° 55′ East Longitude. It is bounded on the north by the Trichinopoly and South Arcot districts, on the west by the Trichinopoly and Madura districts, and on the east and south by the Bay of Bengal and Palk Strait. The area enclosed forms roughly a four-sided figure, the extreme breadth being 70 miles and the length 115 miles. The coast lines is 150 miles long.

In physical character the district naturally divides itself into two parts: (1) the northern portion comprising the delta of the Cauvery and its branches, and (2) the southern or higher tract which lies outside the influence of the river.

2. *Description of Cauvery Delta.*—The Cauvery Delta consists of a gently sloping alluvial plain extending from a point 10 miles west of Trichinopoly to the sea. It includes the east and south portion of the South Arcot district. The non-deltaic portion of the Tanjore district is also chiefly formed of alluvial soil, but it is situated generally on a higher level. It is to this tract that it is proposed to convey water for the new area under the present scheme.

3. *Description of Cauvery River.*—The river Cauvery (vide index map) rises near Mercara in Coorg and drains a considerable area of the Western Ghauts where there is a heavy rainfall in the south-west monsoon. This monsoon gives the greater part of the water to the river and occasions the highest floods

4. *Sources and amount of water-supply.*—The portion of the catchment area fed by the south-west monsoon is 15,700 square miles and the highest normal discharge from it is on an average about 137,000 cubic feet per second and may be expected usually in the months of July or August.

After leaving Mysore the Cauvery begins to come within the influence of the north-east monsoon, and before entering the delta receives a good supply from this monsoon towards the end of the year.

The portion of the catchment area, subject to the north-east monsoon, is about 10,000 square miles, and the maximum discharge due to it may be expected in October or November.

5. *Discharge of the Cauvery.*—The average total yearly June to January discharge of the Cauvery at the head of the delta (Upper Anicut) is 425,000 millions of cubic feet, the drainage area here being 26,172 square miles. Of the total discharge, 335,000 millions of cubic feet is applied by the south-west monsoon (June to middle October) and 90,000 millions by the north-east monsoon (middle October to January).

6. *Description of the Cauvery Delta.*—The head of the Cauvery Delta is 10 miles west of Trichinopoly (vide map of irrigated area). Here the river bifurcates into two large branches, of which the northern takes the names of Coleroon while the southern retains that of Cauvery. For the sake of distinction the main river above the bifurcation is sometimes know as the Agunda (wide) Cauvery.

The Coleroon is really the main channel of river and carries the bulk of the flood water to the sea. It flows in an easterly direction along the northern boundary of the Tanjore district and enters the sea at Devakota, a little south of Porto Novo.

The Cauvery or southern branch is utilized as the main channel for the supply of irrigation water to the fields of the delta. It divides and subdivides into innumerable-branches which form a net work of distributaries all over the delta.

Some ultimately find their way into the sea while others are lost in the wide expanse of rice-fields. The one which retains the name of Cauvery throughout enters the sea, reduced to an insignificant stream, at Cauveripatam, about 8 miles north of Tranquebar.

The whole surface of the delta is a vast stretch of rice-fields interspersed with topes or clumps of coconut and other fruit trees.

7. *Description of existing Cauvery Delta Irrigation Works.*—The alluvial soil of this part of the country is very fertile and, with sufficient water, yields abundant crops of rice. Irrigation from the Cauvery and its branches has been practised from very ancient times. There are many old native works existing and still in use for damming up water in the various river channels and turning it on to the neighbouring land. Many or most of the channel seem to be of artificial origin, and the character of the works remaining shows that, under some of the old native rulers, the irrigation system of the country must have received considerable attention.

The total area of deltaic existing irrigation under the Cauvery and Coleroon is slightly in excess of one million acres.

The irrigation works supplying this area are divided into two systems, viz.—

	Approximate areas irrigated. ACS.
The Cauvery Delta system	895,000
The Coleroon Lower Anicut system	108,000

Both systems are supplied by water from the flow of Agunda Cauvery at the Upper Anicut and together form the irrigated deltaic area of the Cauvery river.

The Cauvery Delta system has its headworks at the Grand Anicut 20 miles below the Upper Anicut. Here the Cauvery bifurcates forming two main irrigating rivers names—

The Cauvery (the left branch).
The Vennar (the right branch).

Across the head of each of these branches is built a regulator with ~~left~~ lift shutters.

The Grand Anicut is a weir connecting the left end of the Cauvery Regulator with the left bank of the Cauvery on Srirangam island.

This weir (the Grand Anicut) is an old native work which has been remodelled and fitted with lift shutters of large span, giving in combination with the Cauvery and Vennar head regulators complete distribution control of the water in the Cauvery at this place. The weir holds up the water of the Cauvery and forces it with the Cauvery and Vennar branches. In its absence this water (except in flood time) would run into the Coleroon (the main river over the channel now blocked by the Grand Anicut).

The Lower Coleroon Anicut system has headworks at the "Lower Anicut", a weir with large span lift shutters which is built across the Coleroon, 70 miles below the Grand Anicut. From each flank of the Lower Anicut canals take off irrigating a total area of about 108,000 acres.

The actual method by which the supplies to the area under this anicut, that is, the flow in the Coleroon below the Grand Anicut, is fed is not clearly traceable.

The system of regulation in force at the Upper and Grand Anicuts only provides for passing surplus water into the Coleroon and thus the flow in this river except in flood time is derived from leakage through the Upper and Grand Anicuts and other surplus works, drainage from wet cultivation—leakage and percolation from the marginal lands in which the water level is in the irrigation season higher than the ordinary flow level in the Coleroon. It is found, as a fact, that although no definite supply through works is being passed to the Coleroon, there is always an adequate supply in that river for the Lower Anicut system when the supplies in the Cauvery system are adequate. It is convenient to add here that allowance in the working tables of the new reservoir has been made for the area under the Lower Coleroon Anicut system as well as for that under Cauvery Delta system, and the area of "existing of irrigation in the delta," constantly referred to in the report, includes the area under both systems.

8. *Non-deltaic irrigation.*—The Cauvery and its tributaries irrigate considerable areas in the Madras Presidency above the Upper Anicut by direct flow through channels. The total area so irrigated is nearly 160,000 acres.

This area is made up as follows :—

The Bhavani river irrigates by direct flow an area about 39,000 acres. The principal systems are the Thadapalli and Arankottai channels under the Kodiveri anicut and the Kalingaroyen channel under an anicut of the same name.

The Noyel river irrigates direct or through tanks an area of 14,500 acres. There are a succession of anicuts across this river to force the water into the channels taking off from it.

The Amaravati river irrigates about 44,000 acres by direct flow. There are a number of anicuts across this river as in the case of the Noyel to raise the water to the required level.

The Cauvery irrigates by direct flow through a number of channels taking off from it above the upper anicut an area of about 62,500 acres distributed as follows :—

	ACS.
In Coimbatore district above the site of the proposed reservoir ...	1,000
In Coimbatore district below the reservoir site	4,500
In Salem district below the reservoir site	7,000
In Trichinopoly	50,000

Water is forced to most of these channels during the low river stages by temporary groynes (korambus) made with brushwood and sand run up the river bed from the head of the channel.

9. *Defects and deterioration of old Delta Irrigation Works.*—From want of proper control over the water distribution and floods, however, the system of irrigation under native rulers must have been defective from the first Then, for more than a century before the advent of British rule, the irrigation works had been entirely neglected owing to the disturbed state of the country, and when the East India Company took over the Tanjore district in 1801, the irrigation in the delta was rapidly deteriorating, the channels were silting up and the land being left uncultivated for want of water-supply.

10. *First improvements.*—Great efforts were made by the district officers to remedy this condition of affairs. For many years these were mainly directed towards trying to remove the sand deposits in the Cauvery which formed the principal obstruction to the free flow of water by providing a number of scouring sluices and outlets at suitable places discharging into the Coleroon which, for about 20 miles, flows parallel to, and at a short distance from, the Cauvery. But it was not however until 1836 when the Upper Anicut was built across the head of the Coleroon by Sir Arthur Cotton that the difficulty of water-supply was finally overcome. The supply, indeed, then became during floods more than ample and, through its very overabundance, became a source of danger, causing serious erosions to the bed and banks of the Cauvery till it was curtailed by building a grade wall, (the Cauvery dam) across the head of the Cauvery in 1845.

When the Upper Anicut was built another large dam (the Lower Anicut) was also built across the Coleroon, 70 miles lower down, to remedy the loss to the irrigation channels which take off here occasioned by the diminished supply to the Coleroon caused by the construction of the Upper Anicut.

11. *Further improvements.*—Since the Upper Anicut was built many other works have been carried out with the object of improving the irrigation of the delta. These consist chiefly of large regulators across the heads of the main channels and have been of great service in controlling floods and apportioning the water-supply.

The most important of these works was the construction in 1887 to 1889 of the Cauvery and Vennar Head Regulators at the Grand Anicut (vide plan following) which places under complete control all normal flow of the Cauvery below the Cauvery dam and enables water to be distributed in proportions wished between the Cauvery and Vennar, the great irrigating rivers supplying the whole Cauvery delta in Tanjore district.

12. *Latest improvements.*—The question of water distribution and flood control has of late received great attention. Several new regulators of a modern and powerful type have been built. The Upper Anicut was cut down and rebuilt in 1899 to

1902 as an open dam with 55 vents, 40 feet wide, fitted with lifting gates which allow a much freer passage for flood water while enabling an extra 1 foot of depth to be forced into the Cauvery. The lower anicut has also been converted into an open dam with 60 iron gates, each measuring 34 feet × 6 feet and it is now capable of heading up water when necessary to a level 2 feet higher than before conversion.

13. *Increased prosperity and increased assessment.*—Owing partly to the steady and continuous improvements of the irrigation works of the Cauvery delta, and partly to the general rise in prices of produce, the land has risen in value and at the last revenue settlement of the Tanjore district in 1893–1894, it was found equitable to raise the assessment on the lands supplied by the Cauvery by as much as 32 per cent on the average. The fact however remains that the supply to the delta is still capable of great improvement, which can however only be given satisfactorily by means of storage, a scheme for which is embodied in this report.

14. *Tanjore rice crops.*—Practicably the whole of the irrigated area in the Cauvery delta is given up to rice cultivation and of the total irrigated area about 10 per cent produces two crops in the year.

There are many kinds of rice cultivated, of which the three most commonly grown are—

(1) Kar. (2) Semba. (3) Pisanam.

(1) Of the *kar* crop there are 12 varieties with periods of growth of from four to six months.

(2) The *semba* is usually grown as a second crop to the *kar* on double crop lands. There are 17 varieties of this with periods of growth of from four to five months.

(3) *Pisanam* is commonly grown where only a single crop is raised and of this there are six varieties with periods ranging from five to seven months.

The time for rice cultivation is not uniform throughout the delta, but differs in various localities, being influenced by the local conditions of river-supply and rainfall.

15. *Conditions of irrigation water-supply.*—As will be seen from the map the Cauvery enters the delta at the narrow western corner or neck and its waters are distributed over an ever-widening expanse of country on their way to the sea. The volume available in the channels is consequently much reduced as they proceed eastwards and the porous nature of the soil in the more northerly part of the tract tends to still further diminish the supply by absorbing large quantities of water.

This is especially the case when the first freshes come in June after the country and its water courses have been dry for many weeks. As is only to be expected, therefore, the land towards the west receives a much earlier and more abundant supply than that towards the coast. The supply of the latter portion of the delta would indeed be very deficient if it were not for the fact that the porous character of the soil already referred to enables it to store up a considerable quantity of the river supply which afterwards drains out and is partly given back to the channels in the form of spring water for the benefit of the lower land. As we go east too the rainfall and especially that from the north-east monsoon is heavier making up in a great measure for the diminished river supply.

16. *System of rice cultivation.*—Throughout the delta rice is invariably grown from transplanted seedlings, it is never sown in the fields on which it is grown. The seed is first sown thickly in seed beds and after about 25 days the seedlings are transplanted into the liquid mud of the rice fields which have been prepared to receive them.

The seed beds are usually watered either by early freshes in the river, or water is obtained for them by baling from wells or spring channels.

Any water in the river in excess of what is necessary for the seed beds before the time of transplantation, generally runs to waste as the ryots object to using it on their fields or wetting them until just before transplanting. They prefer the ground to remain dry and get thoroughly aerated. The lands which bear a double crop are practically confined to the western part of the delta where the water-supply is best. A north and south line through Kumbakonam may be taken as about the limit of the double crop land.

17. *Double crop lands.*—In this portion of the delta it is customary on lands where two crops are grown, to transplant the first crop (a short one) as soon as possible after the arrival of the *early fresh in June* so that it may be harvested in September before the break of the north-east monsoon which is expected about the middle of October. This crop is at once followed by a longer crop for which seedlings have already been matured.

18. *Single crop lands.*—When only a single crop is grown it is a long one taking usually six or seven months to mature. In the west of the delta it may be planted out in July but more usually it is transplanted in August and harvested in January or later.

In the east where the proportion of double crop is very small the cultivation may begin in August, but it frequently begins in September, the crop being harvested in March. The reason for the later date for cultivation in the east is the fluctuating and uncertain nature of the supply which local rainfall cannot be counted on to supplement effectually till October.

19. *Conditions of cultivation.*—The rice cultivation of the delta depends on the Cauvery floods in the first place and secondly on local rain. The regular freshes begin about 18th June and continue more or less uninterruptedly till about the middle of October when they begin to subside This is just the time when the pisanam crops begin to mature. For about a month-and-a-half after this they require water and have to depend on the north-east monsoon rain. This is an anxious period for the cultivators, and if there is a serious failure of the local rains the outturn is certain to be much below the average.

Another anxious time is the preceding interval between the two monsoons, i.e., from 1st September to 15th October. The ideal of a good or successful season presumes a fair river supply and good local rain in this interval. If there is a normal river flow and two inches of rain in a fortnight, the irrigation does not suffer; while if there is four inches of rain the crops are independent of the river. The rainfall, however, is seldom of itself sufficient and without the probability of an adequate river supply in addition to this time the present large area of rice cultivation in Tanjore would be impossible.

20. *Condition of river supply and rainfall.*—Taking the delta as a whole it is observed that both the river supply and rainfall are precarious. The Cauvery being very heavily drawn on when low, frequently runs short, with the result of deficient crops, and occasional complete failure in places. Consequently Tanjore irrigation is at present far from satisfactory and susceptible of considerable improvement.

21. *Project for protection by storage.*—Attention was long ago given to the question of protecting the delta by storage, and it is partly with a view to this protection that the present project has been schemed, though a considerable extension of irrigation is also contemplated as there is sufficient water available for both purposes.

22. *History of the Cauvery Project—Sir Arthur Cotton's proposal.*—The idea of protecting the wet cultivation of the delta by storage of flood water is a very old one. The first proposal appears to have been made by Sir Arthur Cotton as long ago as 1834, but no attempt seems to have been made to ascertain the practicability of the scheme.

23. *Major Lawford's proposal.*—In 1856 Major Lawford submitted proposal for the construction of a reservoir on the Cauvery near Neringipet, but withdrew them after personally communicating with and inspecting some of the work of Mr. W. Frazer, a Civil Engineer, then employed in examining the valley of the Bhavāni and its tributaries for suitable sites for the reservoirs. In doing so he gave it as his opinion that he did not now consider the valley of the Cauvery the best site for the construction of the first reservoir.

The reasons for this change of opinion do not seem to be on record but in all probability it was because the site near Neringipet is not suited to the formation of a reservoir by the construction of a high earthen bank.

24. *The Bhavāni River.*—The Bhavāni is a small but important tributary of the Cauvery taking its rise in the Nilgiri Hills and joining the main river at the town of Bhavāni nine miles above Erode on the Madras Railway. Though the catchment area

of this river is only 2,480 square miles, it is well supplied by the rainfall of both monsoons and its yearly discharge amounts to 70,000 millions cubic feet or about one-fifth of the annual discharge of the Cauvery above its junction with this river.

25. *Mr. Frazer's schemes.*—Mr. Frazer found several suitable sites on the Upper Bhavāni, but the best was reported to be at Pallavoor at the junction of the Bhavāni and Siruvani where the drainage area is 304 square miles. It was found that a reservoir of 13,500 millions cubic feet capacity could be formed here, but the dam would have to be 155 feet high. Apparently that was considered an insuperable objection and the project seems to have been dropped for a time.

26. *Captain Smith's investigation.*—It was taken up again under the orders of Government issued in December 1869 and Captain C. J. Smith, R.E., undertook the further investigation of reservoir sites in the Bhavāni valley. This investigation, owing to Captain Smith's illness, was not completed, but had proceeded far enough to enable that officer to decide that the best site was somewhere between Satyamangalam and the junction of the Moyar with the Bhavāni.

27. *Major Montgomerie's proposal.*—Up to this time there seems to have been no intention of using the proposed reservoir or reservoirs for any purpose other than for the improvement and protection of irrigation in Tanjore, but in 1880, when Major P. Montgomerie took up the question he came to the conclusion that it would be possible to give water for local irrigation also. He drew up an elaborate report reviewing all that had been done previously and giving all the information then available.

Assuming the discharge of the Bhavāni to be 75,000 millions cubic feet annually he thought that two-thirds of this might be passed down the river and one-third used locally for new irrigation. He suggested that a reservoir, with a capacity of 27,000 millions cubic feet, should be formed by damming the river at a site four miles above Satyamangalam and that a channel should be dug from the reservoir to command 500 square miles of country down towards the Amaravati river of which area he calculated on being able to irrigate 75,000 acres. The cost of the scheme was put at 40 lakhs and the revenue derivable from it at 11 lakhs. This estimate was based on insufficient data and the figures afterwards proved entirely incorrect. But the report drew attention to the necessities of the case and in 1883 Captain Romilly, R.E., was put in charge of the investigation.

28. *Captain Romilly's investigation and proposals.*—His report with the Irrigation Chief Engineer's (Colonel Hasted, R.E.) review of it, is printed in G.O. No. 933 I., dated 15th October 1884.

The result of Captain Romilly's investigation was that there were reported to be two suitable sites for the construction of large reservoirs on the Bhavāni one 4 miles above Satyamangalam and another 6 miles higher up.

He calculated that if a supply of 12,000 millions cubic feet were insured from the Bhavāni in September and 8,000 million cubic feet in October, 5½ feet depth might as a rule be maintained on the Cauvery dam at the upper anicut and the cultivation of the delta would thus be protected from short supply between the monsoons, that is, if this supply could be sent down without loss.

He prepared rough estimates for reservoirs varying in size from 8,000 millions to 30,000 millions cubic feet capacity. He was of opinion, however, that the construction of any reservoir would be unprofitable if a financial return from any benefit to Tanjore irrigation was reckoned upon, but advocated rather the construction of his smallest reservoir (8,000 million cubic feet capacity) at the *higher* site chiefly for local irrigation, calculating the return at 17 per cent or more. He allowed in this case only 13-0-0 millions cubic feet for the protection of Tanjore, but he doubted if Tanjore irrigation could benefit at all from water stored for the purpose in a reservoir even of the largest size practicable on the Bhavāni valley owing to its great distance and to the great loss by absorption in transmission.

29. *Colonel Hasted's Review of Captain Romilly's investigations and proposals.*—Colonel Hasted in reviewing his report differed from him as to the proper site and as to the feasibility of protecting Tanjore irrigation, and thought that a reservoir of

16,000 millions cubic feet capacity (as giving the cheapest storage per unit of capacity) ought to be constructed at the lower site. It would give the required 20,000 millions cubic feet in September and October as well as providing for 50,000 acres of local irrigation. He expressed no opinion as to the return to be expected.

30. *Order of Government on Colonel Hasted's views.*—Government in passing orders on the report agreed generally with Colonel Hasted's views, but did not require further investigation or say what was to be done. Nothing apparently was done or at least nothing is on record till 1892 when Mr. J. C. Larminie, then in charge of Coimbatore division, took up the work.

Since then the subject of storage for Tanjore and Coimbatore irrigation has been constantly to the fore and the records have become very voluminous and confusing owing to the great variety of opinion among those concerned as to the best plan to follow and also to the way in which their opinions were modified as discussion on the subject proceeded.

31. *Mr. Larminie's first proposal.*—At first, after some preliminary investigation, Mr. Larminie was in favour of a reservoir at Captain Romilly's upper site and submitted an approximate estimate for one of 16,000 millions cubic feet capacity to ensure the required protection to Tanjore (20,000 millions cubic feet in September and October) and to irrigate 50,000 acres locally.

Then a discussion arose as to the proper site for the dam. The lower site was generally preferred and a great deal of money was spent in examining it and one or two other sites somewhat higher up by trial pits and trenches. Finally, in 1898, a site, seven and half miles west of Satyamangalam, was selected as affording the best rock foundation for the dam.

32. *Mr. Hughes's first Bhavani project.*—Meantime, in 1897, Mr. Hughes became Chief Engineer for Irrigation and he took the project into his own personal charge with the intention of completing it at an early date. He wished also to make it a productive work, and with this object gave up the idea of local irrigation in Coimbatore, as investigation showed that he could not make a combined project pay.

As may be seen from his preliminary report issued in November 1898, he proposed a reservoir of 27,000 millions cubic feet capacity formed by constructing a dam, partly of earth and partly of masonry, across the Bhavani valley at the site fixed upon. Eighteen thousand millions cubic feet of the water stored was to be reserved for protection of Tanjore irrigation, and passed down during the interval between the monsoons in September and October.

To make the project pay he proposed to provide water for 100,000 acres of second crop in Tanjore, and to begin sending it down on May 15th to enable an early crop to be got in everywhere. He also proposed to provide for an extension of the wet cultivation in the Tanjore district by 50,000 acres. This was to be supplied through the medium of the new supply channel of the Pattukkōttai project then under preparation. He reckoned on the Cauvery floods being able to supply this new irrigation for about four months and consequently on its only being necessary to give two months' supply from the reservoir. The cost of the project he calculated to come to Rs. 1,69,00,000 and expected a yearly return of about Rs. 7,00,000 from second crop and irrigation extension.

33. *Mr. Larminie's objections.*—The proposals were criticised by Mr. Larminie who acted for Mr. Hughes when on leave. He objected to the site fixed for the dam, and to the Bhavāni water being used solely for the benefit of Tanjore. He pointed that since the construction of the new Cauvery-Vennar Regulators in 1887, the average annual remissions had only been 0·39 per cent of the net revenue In fact he thought that Tanjore was getting quite enough in the way of improvements to irrigation in the works of the "Cauvery completion estimates" and that the dry, poverty-stricken tracts of Coimbatore ought to receive first consideration under this scheme.

34. *Committee of Inquiry.*—On this His Excellency Sir Arthur Havelock directed that Mr. deWinton (Chief Engineer), Mr. Larminie and Colonel Smart (then employed on the Cauvery completion estimates) should form themselves into committee to go into the question and submit a report to Government.

On his return from leave Mr. Hughes was also directed to join the Committee and Mr. Larminie was placed on special duty for the further investigation of the project.

In their report, dated 10th January 1900, Mr. deWinton agrees with Mr. Hughes's proposals, but Colonel Smart dissents from the resolution that all idea of direct irrigation in Coimbatore should be given up. He also thought that before deciding finally on the site for the reservoir a full investigation of the capabilities of the Cauvery for storage purposes should be made.

35. *Mr. Larminie's further objections.*—Mr. Larminie had gone on leave before the Committee had prepared their report, but before going he addressed a letter to the Chief Engineer for Irrigation in which he drew attention to an objection that had hitherto been overlooked, viz., the injury that would be done to Tanjore irrigation by drawing upon the early freshes to fill a reservoir on the Bhavani.

He pointed out that the recognized full supply for the delta in the south-west monsoon is 6 feet on the gauge at Cauvery dam (upper anicut). The upper anicut was built to provide that full supply in the Cauvery, and the Tanjore cultivators have a right to expect it whenever it comes naturally, and that it should not be interfered with by any arrangements for storage. Nothing should be held back except the surplus over the 6 feet discharge which now runs to waste over the upper anicut.

Mr. Hughes had proposed to make 4·8 feet on the gauge at Cauvery dam the standard, and to hold back all Bhavani water for storage as long as the water level exceeded that. As the river fell the water would be returned to keep it up to that level.

Mr. Larminie contended that such interference with the Tanjore irrigation supply would be most injurious, and as he showed that such a large reservoir on the Bhavani could not be filled by holding back Bhavāni water only when the gauge at Cauvery dam reads over 6 feet; he therefore condemned the project as it stood and advocated instead the construction of a large reservoir on the Cauvery which could be worked without interfering with the 6-feet standard gauge reading.

36. *Effect of Bhavāni floods on supply.*—Floods in the Bhavāni and Cauvery come in the same seasons, and if the freshes from both rivers came simultaneously, this objection could not hold good. The abstraction of the Bhavāni flood water would not much affect the gauge reading as the quantity is so much less than that from the Cauvery. But, as Mr. Hughes himself observes, the chances are against a Bhavāni fresh coinciding in time with a Cauvery fresh (preliminary report). It may usually be expected to come a little before or after the maximum of the Cauvery fresh. The result for the purposes of irrigation is beneficial as in a natural way the total flood discharge is to a certain extent regulated, the maximum rate of discharge is reduced, and the period of low fresh is lengthened. The Bhavāni freshes therefore, though comparatively small in quantity, play an important part in keeping up the supply to the delta and cannot be held back except at rare intervals without materially altering the conditions of irrigation. It would be different if there were one or more large storage reservoirs on the Cauvery by which the Cauvery floods might to a certain extent be regulated. Almost all the Bhavāni flood water might then be taken for storage and in this way a large reservoir on the larger river would greatly add to the efficiency and value of one on the smaller. But until such a reservoir is constructed on the Cauvery there will always be a difficulty in retaining sufficient water to fill a reservoir of any considerable size on the Bhavāni.

37. *Colonel Smart's proposal.*—Colonel Smart then took up this question very vigorously. He agreed with Mr. Larminie's views as to the reduction of the full supply level at the Cauvery dam (upper anicut) and also insisted that Mr. Hughes's allowance for early supply was far from sufficient considering the great extension of second crop contemplated. The water instead of finding its way to the seed beds and fields would, he stated, be nearly all absorbed in the dry sandy beds of the delta canals. He, therefore, made out a proposal for the construction of a large reservoir on the Cauvery, and showed that such a reservoir would, besides giving more efficiently all he protection intended for Tanjore without reducing the full supply level at Cauvery

dam, allow of a very large extension of wet cultivation. The early supply he considered unnecessary and thought that the ryots ought rather to be encouraged to find their own water for early seedlings by baling from wells, as is even now customary in some parts of the delta.

38. *The Bhavani project controversy.*—A very animated controversy then arose between those two officers (Mr. Hughes and Colonel Smart) as to the merits and disadvantages of the two schemes. Mr. Hughes objected to the Cauvery reservoir chiefly on the grounds that it would trap a great deal more silt than one on the Bhavani and would therefore not only become useless from want of capacity very much sooner, but would deprive the water of much of its fertilizing value.

39. *Mr. Hughes's final Bhavani project.*—Meantime Mr. Hughes completed his Bhavani project and issued his final report on it. He had by this time somewhat modified his views. He proposed now to begin the early supply on June 1 instead of on May 15 to supply water for 94,000 acres of second crop and to irrigate 90,000 acres of new wet cultivation. The cost of the scheme was now put down at Rs. 1,13,40,000 and the revenue return, according to the Revenue information (G.O. No. 122 I., dated 5th February 1900), was expected to be Rs. 4,00,000.

40. *The Inspector-General's decision.*—The papers relating to the discussion between Mr. Hughes and Colonel Smart were laid before Mr. (now Sir Thomas) Higham, Inspector-General of Irrigation. He went into the whole question very carefully and thoroughly, and came to the conclusion (vide his note dated 24th August 1901) that a reservoir on the Cauvery would be likely to prove more powerful and remunerative than one on the Bhavani, provided the abstraction of silt from the Upper Cauvery water by deposition in the reservoir did not so materially affect the irrigated area by diminution of fertilizing material deposited on the fields as to constitute a bar to carrying out the proposals.

His remarks on the diminution of the capacity of the reservoir by deposit of silt were based on erroneous data regarding the percentage of silt to be dealt with and need not further be considered here.

41. *Decision regarding manurial value of the silt of the Cauvery water.*—As regards abstraction of fertilizing silt from the water, experiments were undertaken and samples of silt from the Cauvery, Bhavani and Amaravati were submitted for analysis on receipt of the above note. These enquiries showed that the manurial value of the silt from the tributaries named was materially greater than that of the Upper Cauvery. This agrees with the opinions of the ryots who prize silt from Bhavani and Amaravati floods (especially the latter) much more highly than that of the Cauvery. It has been decided that the abstraction of the silt deposited in the bed of the Cauvery reservoir is not a material objection to the construction of such a work.

42. *Mr. Moss's Cauvery Reservoir project.*—It was now decided to draw up a detailed project for a reservoir on the Cauvery, and this was drawn up by Mr. H. A. Moss and is fully described in that officer's report (appendix I of G.O. No. 971 I. of 2nd September 1904).

This report has been drawn on very freely for much of the above information regarding the existing conditions of cultivation and the history of previous proposals.

Mr. Moss's project embraced a reservoir of capacity 40,000 mill. c.ft. with a masonry dam 130 feet high across the Cauvery three miles above Neringipet; and this was designed—

(*a*) to protect all existing irrigation area in the Cauvery delta and to extend the double-cropped area in this to a total of 160,000 acres;

(*b*) to extend irrigation to new areas to a total of 216,000 acres in Tanjore district;

(*c*) to irrigate, by channels taking off direct from the reservoir, 46,000 acres on both sides of the Cauvery in Salem and Coimbatore districts.

The proposals included the construction of a large tank (with an earthen bund) in the Tanjore district near Pattukkottai to supplement in the north-east monsoon the supplies to the new area in that taluk.

The total estimate for the cost (after some revision) amounted to 292·3 lakhs and the net revenue to 13 lakhs. This project was forwarded to the Government of India for sanction with letter No. 597 of 13th June 1906.

43. *Revised proposals of the Inspector-General of Irrigation.*—The project was returned by the Government of India letter No. 37 I. of 8th January 1907 with a note by the Inspector-General of Irrigation, dated 17th September 1906 (Appendix I), suggesting the abandonment of the channels taking off direct from the reservoir which traversed difficult country and making an endeavour to get an area more suitable for irrigation in the south portion of Tanjore district by extending the new irrigation there proposed further to the south of Pattukkottai taluk.

44. *The Kattalai Canal scheme.*—Further investigation shewed that the modified proposals required a canal taking off the Cauvery either at the Grand Anicut or above this point.

Two definite schemes were investigated, one of which was for a canal to offtake at Kattalai just below the confluence of the Cauvery and Amravati. Preliminary estimates for this scheme shewed that the cost would be such that a paying scheme would require an area of new irrigation about 490,000 acres as against 330,000 acres, the paying area for the Grand Anicut Canal scheme (the other scheme contemplated). The Kattalai Canal scheme was considered preferable on the ground that a canal on this alignment of canal gave scope for extensions of irrigation to areas much larger than the above, while the Grand Anicut line did not afford any considerable scope for future extensions.

45. *Result of the flow observations of the Cauvery and adoption of the Grand Anicut Canal scheme.*—The question of water-supply available for such large areas and for any extensions was now considered, and it was decided that the information available was not sufficiently accurate to settle this question and special flow observations were taken during the year 1909 for the more accurate graduation of existing gauges and determination of water-supplies which could be counted on. The results were collated and considered in January 1910 on the visit of the Inspector-General of Irrigation (Mr. J. Benton) to Madras and are recorded—G.O. Madras No. 72 I. of 11th March 1910 (Appendix I). Having in view that the primary object of the works was to improve and protect the irrigation of the existing delta, the Inspector-General accepted the recommendation of the Chief Engineer for Irrigation to prosecute the *Grand Anicut Canal scheme* involving a smaller area of new irrigation and more assured supply to the existing cultivated area.

46. *Present condition of Bhavani Reservoir project.*—At present the estimates for a reservoir on the Bhavani are in abeyance pending the disposal of the Cauvery Reservoir project proposals which, it has been decided, should take precedence.

The latest proposals for which estimates have been worked out under the control of Mr. H. E. Clerk (Special Superintending Engineer) provided for a reservoir of capacity 17,736 mill. c. feet with a combined masonry and earth dam at Kottamangalam just below the confluence of the Bhavani and Moyar rivers about ten miles above Satyamangalam.

The storage to supply 109,000 acres of wet first crop and 80,000 acres second crop by a canal with head at the dam site and irrigating in the Satyamangalam, Bhavani and Erode taluks of Coimbatore district.

The major portion of this proposed ayacut is in the Erode taluk.

SECTION II.

Scope of Present Project and Details of Water Distribution.

47. *Scope of the Project.*—The project now submitted provides for the following:—

(*a*) Constructing a masonry dam across the Cauvery at Metur and forming a reservoir of effective capacity 80,000 mill. c.ft.

(*b*) Constructing a canal and distribution system offtaking from the right of the Cauvery just above the Grand Anicut to supply Cauvery water to a new area of 285,304 acres. This system will be called the "Grand Anicut Canal system."

(*c*) Remodelling and extending the existing irrigation canal called the "Vadavar" and constructing a distributary system to supply with Cauvery water a new area of 43,091 acres This system will be called the "Vadavar system."

(*d*) Improving (by means of the reservoir) the water distribution and supply to the existing wet area in the Cauvery delta (roughly 1 mill. acres) and for extending in this area the extent of double-cropped lands by 70,000 acres.

The above gross area includes irrigation under the Coleroon Lower Anicut system (about 100,000 acres).

48. *Effect of the reservoir on cultivation seasons.*—The whole project hinges on questions of seasonal supplies of river water, seasonal rainfall, and seasonal requirements of irrigated crops, and the function of the reservoir is to store and distribute the water available to the crops so as to benefit and secure these to the greatest extent possible.

The existing cultivation customs and seasons of cultivation, as described in section I, are those which experience has shown to be most suitable for the raising of wet crops, with the existing seasonal distribution of river flow and rainfall.

The effect of the reservoir on these seasonal supplies will be—

(*a*) to secure an adequate supply at an earlier average date than heretofore both for double and single crop lands and to guarantee that once such supply is issued it will not, as at present, be subject to fluctuations of a nature which cannot be foreseen;

(*b*) to ensure from the time of transplantation a steady and adequate flow for the irrigated area, by impounding excess flow, for issue when the natural flow is deficient.

The general effect of this alteration on the cultivation practices will be to make transplantation of both double and single cropped lands earlier, and this specially applies to the single-cropped lands in the eastern part of the delta, which now delay transplantation on account of the frequent failure in September and October of flow supply which is generally available in July and August, thus leaving early transplantation to wither before the north-east monsoon rainfall is available to supplement the flow supply.

49. *Working tables.*—For the purpose of forecasting the prospects of cultivation and the effect of the storage proposed, working tables for the reservoir have been drawn up from the daily flow of the last 20 years. For the purpose of these tables it is assumed that the reservoir and new irrigation area now proposed, were in existence for all this period, and the daily receipts and issues of water, at the duties required for such extended areas, are recorded with the daily balances. From this computation of what would have happened in the past 20 years had the proposed works been in existence, the prospects of the future are assumed.

The tables with full details regarding the data on which water-supply is computed, and requirements for irrigation fixed, are printed in volume III to which reference may be made for the details and data, on which the general conclusions and statements which follow are based.

50. *Duties of water.*—In fixing the scale of duties of water for the working tables of the reservoir and for deciding reservoir capacity, two scales of duties have been provided—

(*a*) *Scale for the existing irrigated area.*—In framing this, care has been taken to make very liberal allowances based for purposes of full supply on the actuals of recent years passed to the combined Cauvery and Vennar areas.

These supplies are greatly in excess of what would be allowed for a newly-designed system and are allowed in view of the conditions of existing irrigation.

(*b*) *Scale for new area.*—The full supply allowed for this (which also fixes the maximum carrying capacity of the new channels) is based on the actuals realized

under the Vennar section of the Cauvery Delta system to which lands the new area adjoins while the nature of soils are similar. The allowances are supported by the duties worked to in areas in the irrigated tracts in Gōdāvari and Kistna. The table of duties attached gives the allowances made and the average rainfall in the irrigated area. A full detail of the data on which duties are computed is given in volume III.

Cauvery Reservoir.

Duty table showing water allowances on a normal year in millions cubic feet per 24 hours.

Period		Wet Deltaic existing cultivation area						Newly-irrigated area.				Total area.	
		Average rainfall, inches.	Area in thousand, acres.	Duties in acres, per cusec.	Equivalent inches.	Equivalent discharge, millions cubic feet in 24 hours.	Equivalent depth, Cauvery dam.	Area in thousand, acres.	Duties in acres, per cusec.	Equivalent depth in inches.	Equivalent discharge, millions cubic feet in 24 hours.	Total discharge, millions cubic feet in 24 hours.	Equivalent depth water on Cauvery dam.
1		2	3	4	5	6	7	8	9	10	11	12	13
June ..	1st half.	0·75	165	40	9·0	356	2·9	75	40	9·0	162	518	3·8
	2nd half.	0·45	165	40	9·0	356	2·9	75	40	9·0	162	518	3·8
July ..	1st half.	0·75	165	40	9·0	356	6·1	75	70	5·1	93	2,135	6·7
			840	53	6·75	1,371		255	70	5·1	315		
	2nd half.	0·9	165	60	6·0	238	6·1	75	70	5·1	93	2,017	6·6
			840	53	6·75	1,371		255	70	5·1	315		
August ..	1st half.	1·7	165	89	4·0	160	5·9	75	89	4·0	73	1,919	6·5
			840	53	6·75	1,371		255	70	5·1	315		
	2nd half.	2·2	165	89	4·0	160	5·9	75	89	4·0	73	1,919	6·5
			840	53	6·75	1,371		255	70	5·1	315		
September ..	1st half.	2·5	840	53	6.75	1,371	5·6	255	70	5·1	315	1,686	6·1
	2nd half.	2·5	840	89	4·0	815	4·7	255	89	4·0	248	1,063	6·1
October ..	1st half.	2·8	840	89	4·0	815	5·0	255	89	4·0	248	1,343	5·5
			165	74	4·8	194		75	74	4·8	86		
	2nd half.	5·4	840	143	2·5	508	4·2	255	143	2·5	154	847	4·7
			165	112	3·2	127		75	112	3·2	58		
November ..	1st half.	6·1	840	178	2·0	408	3·8	255	178	2·0	124	677	4·3
			165	143	2·5	100		75	143	2·5	45		
	2nd half.	5·2	840	178	2·0	408	3·8	255	178	2·0	124	677	4·3
			165	143	2·5	100		75	143	2·5	45		
December ..	1st half.	4·2	840	297	1·2	244	3·0	255	297	1·2	74	503	3·8
			165	112	3·2	127		75	112	3·2	58		
	2nd half.	3·4	165	95	3·75	150	1·7	75	95	3·75	68	218	2·1
January ..	1st half.	0·9	165	66	5·4	216	2·1	75	66	5·4	98	314	2·6

The figures in thick type refer to double crop in columns 3 to 6 and 8 to 11.
The roman figures refer to single crop in columns 3 to 6 and 8 to 11.
On a normal year water will be passed down for double crop from 1st June.
On a normal year water will be passed down for single crop from 1st July.

51. *Dates of supply to double cropped lands.*—Normally the reservoir will issue water for the supply of double-cropped lands on 1st June. Should the supply of water impounded on that date be insufficient to ensure continuous supply, the opening would be postponed and supplies continued at the end of the season to a corresponding later date.

In the 20 years for which the working tables are drawn, it was only necessary to postpone opening in three years, viz.:—

1900	Opens 23rd June
1905	„ 23rd June
1906	„ 1st July

The supply to double-cropped lands is allowed for 7½ months (normally 1st June to 15th January) with one month intermission (1st to 30th September) for harvest of the first crop. Seedlings for the earliest transplanted first crop will, as at present, be raised under wells and spring channels, while for the later transplantations seedling can be raised under the early June supply. This is in accordance with existing practice.

52. *Supply to single-cropped area.*—The normal date of issue of water from the reservoir for single crop is the 1st July. Such an early issue will facilitate early ploughing and preparing fields, raising seedlings, and filling tanks, but actual transplantation will not commence much before 16th July, and from this date only the allowance of water for transplantation and watering the crop is computed. The supply of water for single crop is continued up to 15th December. When the reservoir issues water for supply of this crop later than 16th July, a corresponding later supply is issued at the end of the season giving a minimum period of supply (excluding raising seedlings) of five months.

The years of the cycle of 20 years in which the issue to single crop is after 1st July are as under :—

1900	4th July
1905	8th „
1906	26th „

53. *Remarks on bad years in the period of* 20 *years considered.*—In the 20 years which the working tables cover there are four bad years, meaning by this, years in which either the existing deltaic irrigated area suffered seriously from want of water, or in which the whole area now to be irrigated under the Project conditions would not have been supplied with the full allowances of water required for both single and double crops.

These years were—

1899–1900—the worst year on record.
1904–1905.
1905–1906.
1908–1909.

The conditions of supply for each of these years is noted on separately under headings :—

(*a*) Supply which was actually available for the deltaic area.

(*b*) The supply which would have been available had the reservoir been in existence, and the whole area now proposed for cultivation been under irrigation. The result in each case as regards the whole and the existing deltaic irrigated area is noted on.

54. In working this comparison, it is assumed that the issues of water for the new and for the existing areas have been made as per working tables unless where specified otherwise.

1899–1900.—(*a*) Flow adequate up to middle July.

From middle of July to end of August flow very deficient and the transplantation would have been very late indeed.

September flow normal, and under ordinary circumstances would have been adequate.

From then to end of season flow very inadequate, except in second half October and first half November when, assisted by good rainfall, as it was, it would have been adequate had the early supplies enabled seasonable transplantation to be made, but this was not so and crops suffered accordingly. On the whole the season was very disastrous and a great deal of the single and nearly all late crop was lost.

The actual remission this year was Rs. 6,27,295.

(*b*) An early start is made with the reservoir full and full supplies are given up to middle October and with the plentiful rainfall, 15th October to 15th November, crops would have been in good condition to latter date.

A very deficient supply to the single crop would have been available for the last month, 15th November to 15th December, and on this account a bumper crop would not have been realized, but the whole single crop would have matured. The rainfall in first half December was good. The new canal would have been closed 16th December and all flow of river passed to the old cultivation area. This however would have greatly suffered.

On the whole the first crop would have been successfully matured, but the second crop would have failed almost entirely in both existing and new area.

The benefit this year of the reservoir to the existing area would have been very great.

1904–1905.—(*a*) Supplies normal and ample to middle of August.

Supply very deficient second half August and somewhat scanty throughout September and about normal for October.

From the end of October the river fails very badly and flow is very deficient for rest of the year and from the middle of November almost negligible. The rainfall of November is also a failure.

The single crop suffered severely.

The second crop much of it failed.

The rainfall of December was on the whole good. (The actual remission this year was Rs. 67,057.)

(*b*) Full supplies up to the 15th December and no deficiency whatever in supplies to the single crop. The second crop would only have had deficient supply from 15th December and assisted by the good rainfall of that month, that in the deltaic area would not have suffered severely, if as is proposed in such a case, all flow were passed to the old area from 16th December. The new area second crop would have failed. The old area would this year have derived very great benefit from the reservoir.

1905–1906—(*a*) Supplies normal and sufficient to middle August.

From then to end of October somewhat deficient but not in serious defect.

The rainfall September and first half October was good and thus we may say water-supplies were sufficient to end of October; as in the previous year a great deficiency of river flow in November.

The rainfall was good in November.

In December first half, the river flow is deficient.

On the whole single crop would have suffered but assisted by good rainfall would have all matured.

The flow after 15th December to 15th January somewhat deficient for the late crop and rain very deficient, but a heavy fall on 16th and 17th January saved the situation.

With some loss the late crop in the delta was mostly realized. (The actual remission this year was only Rs. 15,897.)

(*b*) The reservoir gives full supply to end of August. It is empty from 1st to 11th September and 22nd September to 10th October.

The rainfall in this period is good and as in case (*a*) crop would have not suffered.

From 11th October full supplies given to 10th December. Single crop would have been fully realized on full supplies.

For the second crop again it would have been necessary to give preference to the existing delta and the new area second crop would have failed.

Under such circumstances the second crop in the existing area would have been benefited owing to the abundant and adequate supplies up to the 23rd December.

On the whole under the reservoir the existing area would have been slightly better off than it was actually.

1908–1909—(*a*) Supplies ample and up to middle September but somewhat in defect from middle September to middle November. The rainfall of September and October are good, but from the 4th November to end of December there was practically none.

River supplies very deficient from middle November to end of December when very heavy rain saved very extensive total loss of crop.

Both single and second crops suffered severely from want of water. (The actual remission this year was Rs. 35,208.)

(*b*) Full supplies throughout the season to both old and new acres single and double crop. There would have been marked advantage to the existing deltaic tract had the reservoir been in existence this year.

The four diagrams following show clearly the distribution of flow to the existing cultivated wet area in the above four years under conditions—

(*a*) black shaded,

(*b*) red shaded.

55. *Summary of benefits to the existing irrigation.—In 1899–1900* the reservoir would have wholly saved the single crop in the delta and no great loss on this would have been experienced. The delta second crop would not have received any material assistance from the reservoir and this as well as new area second crop would have failed.

In 1904–1905 full supplies in place of deficient supplies would have been given for November and December in place of very deficient supplies to the great benefit of single crop.

The second crop under the deltaic area would have also somewhat benefited.

The new area second crop would have failed.

In 1905–1906 slight, but not any marked advantage, due to the reservoir to both single and second crop. The new area second crop would have failed.

In 1908–1909 marked benefit to both single and second crop from the reservoir, and both new area and old area fully supplied.

In all other years in the cycle of twenty years full supplies distributed as required would have been passed yearly to the existing and new areas for both single and double crops. Full details of these supplies can be seen by reference to the working tables. (Volume III).

56. *Analysis of seasonal flow of Cauvery for the twenty years 1890 to 1909.*—Broadly speaking the measure of water available for irrigation is the flow over the Cauvery dam at the Upper Anicut. *The "irrigation supply"* is the flow of the Cauvery dam limited to a maximum of 7 feet depth. The flow over 7 feet is surplused into the Coleroon over the Grand Anicut. The total requirements at the normal duties, as per duty tables, on a normal year for the area proposed to be irrigated is as below from June to January :—

—	Existing area		New area.	
	Single crop acres, 840,000.	Double crop acres, 165,000.	Single crop acres, 355,000.	Double crop acres, 75,000.
Mills. cubic feet	154,045	40,275	38,989	17,002
	194,320		55,991	
Supply for extension 70,000 acres of existing area double crop	− 4,270		+ 4,270	
Total ..	190,050		60,261	
Grand Total ..	250,311 mills. cubic feet.			

N.B.—For details of these figures see Table at end of this section.

Approximately it may be counted existing irrigation requires 190,000 mills. cubic feet yearly and new irrigation 60,000. Total 250,000 mills. cubic feet.

Comparing the flow required yearly for existing irrigation with the "irrigation supply" which actually passed over the Cauvery dam as recorded for the last twenty years, it is found that the total flow in two years of this period was actually less than the duty requirements, viz.—

	MILLS. C. FT.
1899–1900	157,199
1905–1906	176,636

In the four other years the excess over duty requirements is only very small—

	MILLS. C. FT.
1890–1891	204,209
1894–1895	208,269
1904–1905	216,467
1908–1909	194,662

The flow and rainfall, however, in 1890–91 and 1894–95 was so well distributed that no serious inconvenience was experienced with existing areas in those years; in fact, in those years the distribution by natural flow approximated to that which the reservoir would have given.

The remissions for these years were only Rs. 8,606 and Rs. 11,629.

57. *Limit of well-secured irrigation reached.*—It will be clear from the above figures that the limit of *well-secured* direct irrigation under the Cauvery has been reached, if not already exceeded.

58. *Total amount of water carried to the existing "deltaic" area in the six years considered.*—The total amount of water actually carried to the existing deltaic area in each of the above six years and that which would have been given under the system proposed to same area, had the reservoir been then existing and the existing and also the proposed new area under wet cultivation, is shown in the attached table.

Table showing for the six worst years of last twenty years :—

In Roman figures.—Distribution by half monthly periods of water to existing irrigated area as it actually occurred.

In Clarendon figures.—Distribution by half monthly periods to existing irrigated area supposing the proposed system had been in operation at the time. Where two bracketed clarendon figures appear the upper one is the flow extra to duty allowances which would have been passed to the existing area from surplus water.

[All figures show millions cubic feet.]

Month.		1890–1891.	1894–1895.	1899–1900.	1904–1905.	1905–1906.	1908–1909.
June ..	1st half ..	**5,340**	**5,340**	**5,340**	{ **6,894** **5,340** }	**1,970**	**5,340**
		5,224	6,807	4,696	15,207	4,3[illegible]6	2 382
	2nd half ..	**5,340**	{ **9,743** **5,340** }	**8,777** **5,340**	**23,361** **5,340**	**509** **2,848** }	**5,340**
		9,133	18,681	20,823	28,794	8,246	5,270
July ..	1st half ..	**25,905**	**25,905**	{ **1,954** **25,905**	**2,475** **25,905** }	**16,308**	{ **165** **25,905** }
		12,431	8,869	30,394	34,500	27,439	22,404
	2nd half ..	**25,744**	{ **566** **25,744**	**25,744**	{ **2,417** **25,744** }	**27,632**	{ **1,609** **25,744** }
		27,528	29,060	16,388	36,817	25,594	34,460
August ..	1st half ..	{ **1,644** **29,965** }	**22,965**	**22,965**	{ **2,667** **22,965**	**24,961**	**5,715** **22,965** }
		29,815	23,175	6,902	29,533	22,298	34,509
	2nd half ..	{ **237** **24,496** }	**24,496**	**24,496**	{ **1,494** **24,494** }	**25,189**	{ **1,162** **24,496** }
		22,535	31,010	10,526	22,517	14,509	27,570
September ..	1st half	**20,565**	**20,565**	**20,560**	**20,565**	**17 666**	**20,565**
		12,358	16,644	17,649	5,940	19,020	15,869
	2nd half ..	**12,225**	**12,225**	**12,225**	**12,225**	**7,620**	**12,225**
		7,572	11,814	22,078	14,821	10,600	6,964
October ..	1st half ..	**15,135**	**15,135**	**13,321**	**15,135**	**7,378**	**15,135**
		12,795	6,048	7,340	6,674	11,283	6,374
	2nd half ..	{ **4,359** **10,160**	**644** **10,160** }	**7,737**	**10,160**	**8,978**	**10,160**
		13,320	21,685	10,315	14,102	15,875	12,397
November ..	1st half ..	{ **11,318** **7,620**	**333** **7,620** }	**4,372**	**7,620**	**8,494**	**7,620**
		30,737	17,360	5,830	5,002	4,338	7,663
	2nd half ..	**7,620**	**7,620**	**1,126**	**7,620**	**7,777**	**7,620**
		9,283	7,198	1,504	1,424	5,142	2,546
December ..	1st half ..	**5,565**	**5,565**	**702**	**4,344**	**3,781**	**5,565**
		5,740	6,276	938	322	4,376	1,334
	2nd half ..	**2,400**	**2,400**	**482***	**282***	**1,974***	**2,400**
		4,546	3,636	482	282	1,974	1,696
Jnnuary ..	1st half ..	**3,240**	**3,240**	**782***	**240**	**230***	**7,383**
		1,192	606	782	240	230	11,431
	2nd half ..	*Nil.*	*Nil.*	**552***	**292***	**1,376***	**2,102**
				552	292	1,376	2,802
	Totals ..	**211,878** 204,209	**205,606** 208,269	**182,385** 157,199	**227,579** 216,467	**164,697** 176,636	**209,216** 194,662

* All available flow passed to the second crop on the existing area, the new area second crop being shut off.

Remarks.—In the year 1905–1906, it is to be noted that, although the total proposed supply is less by 11,939 millions cubic feet than actual flow, the distribution is much better. The actual flow between 1st June and 30th June was 12,582 against a requirement of 5,[illegible]00 millions and in the first half July flow is 12,131 cusecs more than the duty allowances. After 16th July the issue of water under the proposed scheme materially exceeds the actual.

59. *Remarks on capacity of the reservoir and how it affects the existing wet area.*—The effective capacity of the proposed reservoir is 80,000 millions cubic feet, roughly one-third the total requirement of water for one year of the whole crop existing and proposed. The reservoir will contain more water when full by 20,000 millions cubic feet than is required for the whole new irrigation. The working tables show that, out of the six years of lowest flow, the reservoir of the commencement of the season (1st June) was full or nearly full in five years containing in every such year materially more than the whole supply required for the new irrigation for a year. In one year only, 1905–1906, being the second of two successive bad years, was the impounded supply small on 1st June. This is the only year of deficient supply in which existing irrigation would not have benefited very materially from the existence of a reservoir, and even in this year the tables show some small benefit to the existing irrigation by improved distribution of the available supply.

60. *Preferential treatment of the existing deltaic area.*—The above statements show that in such a year as any of the above, except 1905-1906, even if the reservoir were worked to give preference to new irrigation, the existing area would benefit. Such a procedure is not, however proposed, but on the contrary it is proposed, where it is practicable to do so, and where the state of water-supply makes differential treatment advisable, to give the existing area the preference.

This matter is treated at some length to make it quite clear that the improvement of supply of old irrigation has been very carefully considered and provided for. Were it not for existing irrigation, a reservoir of much smaller capacity than what is proposed would amply supply the new areas to be brought under wet cultivation.

61. *Supply of water to new area second crop.*—It will be noted from the distribution table (paragraph 58) that after the termination of the single crop season (15th December), in cases where the reservoir cannot assist direct flow, it is proposed to give the whole supply to the existing delta area. In the twenty years of the working tables this occurs three times, *viz.*, in 1899–1900, in 1904–1905, in 1905–1906, and successful raising of a second crop in the new area will be precarious to such an extent.

62. *System of working the reservoir.*—The working tables have been framed, on hard and fast rules for duty, and worked out without allowing for the influence of the varying distribution of each year's rainfall. In practical working this would not be the case.

The control of the reservoir issues would of course always be based on the duty requirement of the creps, but the issues would be modified under directions of a controlling officer from Tanjore or such other controlling centre as may be fixed on.

The controlling officer would receive daily information by telegraph—

(*a*) of the flow of Cauvery entering the reservoir at Hogen Kal falls and the gauge reading of water in the reservoir ;

(*b*) of the flow of Bhavāni from Kodiveri anicut near Satyamangalam ;

(*c*) of the flow of Amravati from Dhārāpuram ;

(*d*) of the flow at the Upper Anicut ;

(*e*) of the rainfall from selected stations in the river catchment and in the irrigated area.

By judicious modification of the duty figures having in view the seasonal requirements and the quantities of water in the reservoir, it cannot be doubted that supplies superior to those shown by the working tables could be provided and it is in the worst years which the benefits of such modifications of hard and fast rules would give best results.

63. *Scope for future extension of project.*—The objection originally made to the alignment of canal now selected for this project was that it afforded little scope for extension of irrigated area in the future.

The gaugings of flow have shown, however, that very large extensions will not be feasible on account of limited water-supply and in consequence the larger "Kattalai Canal Scheme" has been rejected.

It is, however, possible that limited future extensions over the area now provided for may be found feasible.

Such extension might be realised—

(*a*) By extending the Grand anicut canal south of the Narasinga Cauvery.

The country commanded is very suitable for irrigation and a great part of it is already irrigated under tanks fed by the north-east monsoon.

The extension in this direction would have for objective the supply of water to these tanks in the earlier parts of the year—July to October—as well as the irrigation of the existing dry and unoccupied tracts.

(*b*) By enlarging and remodelling the Mulliyar on the general lines proposed in Mr. Moss scheme to irrigate the Tirutturaippūndi block, 20,000 acres.

(*c*) Constructing a canal taking off the left side of the Cauvery at the Upper Anicut to irrigate lands on the north of the Coleroon in Trichinopoly and South Arcot districts.

Such a canal is quite feasible but would be costly to construct on account of the heavy cross drainage works necessary.

(*d*) Extension of double-cropped area in the proposed irrigated tract.

Table from Duty Figures showing Total Water required for crops, Cauvery Reservoir Project.

Yearly.	Single crop.	Double crop.
	MILL. C. FT.	MILL. C. FT.
Duties per acre—		
Existing area	0·183	0·244
New area	0·153	0·217

Month.		In existing area.		In new area.	
		Double crop, 165,000 acres.	Single crop, 840,000 acres.	Double crop, 75,000 acres.	Single crop, 255,000 acres.
June	1st half	5,340	..	2,430	..
	2nd half	5,340	..	2,430	..
July	1st half	5,340	20,565	1,395	4,725
	2nd half	3,808	21,936	1,488	5,040
August	1st half	2,400	20,565	1,095	4,725
	2nd half	2,560	21,936	1,168	5,040
September	1st half	..	20,565	..	4,725
	2nd half	..	12,225	..	3,720
October	1st half	2,910	12,225	1,290	3,720
	2nd half	2,032	8,128	928	2,464
November	1st half	1,500	6,120	675	1,860
	2nd half	1,500	6,120	675	1,860
December	1st half	1,905	3,660	870	1,110
	2nd half	2,400	..	1,088	..
January		3,240	..	1,470	..
Total ..		40,275	154,045	17,002	38,989
		194,320		55,991	
Deduct extension, second crop in delta, 70 × (244 − 183) =		—4,270		add + 4,270	
Balance ..		190,050 mills. c.ft.		60,261	
Grand Total ..		250,311			

SECTION III.

Reservoir and Head Works.

A.—General.

64. *General description of the proposed Cauvery reservoir.*—The position of the proposed Cauvery reservoir is shown on the inset on the index map. The water-spread area stretches from the dam site at Metur up the Cauvery river for 34 miles to the foot of Hogankal falls.

The level of the Cauvery bed above the falls is about + 804, while the low water level below is about 740. The full level of the reservoir is + 785. The drop will thus be generally partially submerged by the backing up of the Reservoir water.

For the first 14 miles below the falls the Cauvery is in a narrow gorge with steep sides and gives little capacity. Below this flat marginal areas of alluvial deposit appear and gradually widen out giving a spread of water up to a maximum width of some 4½ miles just above Sampalli village three miles above the Dam site.

From Sampalli to the Dam site the hills close in again to a width 1½ to 1 miles.

The total area submerged is 54·6 square miles. The submerged area comprises about 20 square miles of assessed patta land, while the balance of the land submerged is either Government waste or reserved forests.

The details of the area and estimate of compensation to be paid will be found in the Revenue officer's report (Appendix II).

The capacity of the Reservoir at various levels is shown in the attached table computed from the 4″ to 1 mile contour map of the Reservoir waterspread.

The method of contouring was briefly as follows :

One actual contour was run and surveyed on the ground and from this cross sections at suitable intervals and up all spurs and valleys were taken with chain and level, and plotted on the village plans on which the contour was also plotted.

For the lower contours (below + 750) free use was made of the surveys from Mr. Moss' project.

From the levels so plotted contours at 10 feet interval were interpolated forming the contoured waterspread map.

A more detailed description of the survey operations will be found in the book of computations of the Reservoir capacity recorded with the project papers.

Table of submerged areas and capacity, Cauvery Reservoir (Metur site).

Level of submergence above M.S.L.	Submerged area including islands.				Total square miles including islands.	Total square miles excluding islands.	Mean area.	Capacity between contours.	Total capacity up to level.	Total fully effective capacity.
	Salem left side.	Coimbatore right side.	Cauvery river bed.	Total.						
	ACS.	ACS.	ACS.	ACS.			M. SQ. FT	M. C. FT.	M. C. FT.	M. C. FT.
630	..	..	357·4	357 4	0·558	0·558	..	77·78	77·78	..
640	..	..	731·8	731·8	1·143	1·143	23·7	237·10	314·88	..
650	..	25·4	995·2	1,020·6	1·595	1·595	38·2	381·6	696·48	..
660	54 6	264·8	1,467 8	1,787·2	2·792	2·789	61·1	611·0	1,307·48	..
670	460·4	803 4	1,922·0	3,186·8	4·978	4·978	108·3	1,082·6	2,390·08	..
680	1,131·8	1,701·6	2,103·6	4,937·0	7·714	7·662	176·2	1,761·9	4,151·98	..
690	1,948 0	2,652·4	2,271·2	6,871·6	10·737	10·711	256·1	2,561 0	6,712·98	..
700	2,813·2	3,888·2	2,801·6	9,503·0	14·848	14·790	355·5	3,554·6	10,257·58	*Nil.*
710	4,191·32	5,071·6	2,941·0	12,203·92	19·069	18·991	470·9	4,708·8	14,976·38	4,708·8
720	5,195 4	6,546 6	3,228·0	14,970·0	23·39	23·219	588·4	5,883·7	20,860·08	10,592·5
730	6,272·92	7,980·2	3,314·88	17,568·0	27·45	27·364	705 1	7,050·8	27,910·88	17,643·3
740	7,507·68	9,317·8	3,405·08	20,230·56	31·61	31·483	820 3	8,202·8	36,113·68	25,846·1
750	9,131·2	10,694·0	3,418·48	23,243·68	36·32	36·216	943·7	9,436·7	45,550·38	35,282·8
760	10,464 4	12,889·0	3,418·48	26,771·88	41·83	41·817	1,087·7	10,877·2	56,427·58	46,160·0
770	12,259 0	14,532·6	3,418·48	30,210·08	47 208	47·061	1,238·9	12,388·9	68,816·48	58,548·9
780	13,611·2	16,214·72	3,418·48	33,244·4	51·944	51·836	1,378·5	13,785 5	82,601·98	72,334·4
785	14,468·16	17,096·0	3,418 48	34,982·64	54·66	54·600	1,483·6	7,418·16	90,020·14	79,752·56

65. *Allowance for silt deposit.*—With a view of determining the quantity of silt yearly carried in suspension by the Cauvery daily samples of water were taken in 1909 from June to December and the weight of silt in each sample measured.

From the computations resulting it appears that the silt in suspension is a little over 100 millions cubic feet yearly, about $\frac{1}{3370}$ of the discharge.

In years of exceptional flood this may be considerably exceeded. Further the above takes no account of rolled sand of which no measure is available.

It is considered, however, an allowance of 200 millions cubic feet yearly is an outside estimate for diminution of reservoir capacity by the deposition of silt, sand, etc. The deep supply sluices in the reservoir are so placed that they cannot give full irrigation supply with water at a lower level in the reservoir than + 700 which connotes a capacity of about 10,000 millions cubic feet. Full details regarding silt observation and data are given in Volume III.

66. *Sites for the dam considered but rejected*—(i) *Neringipet site.*—In the previous project by Mr. H. A. Moss, the site selected for a reservoir was at Seccanur 4 miles above Neringipet and 20 miles above Bhavāni.

This site is described in detail in Mr. Moss' report (page 22). The great recommendation of this site appears to have been the facility with which it lends itself to the off-take of right and left marginal canals direct from the Reservoir.

These formed a feature of Mr. Moss' project which has, on the recommendation of the Inspector-General of Irrigation, been abandoned.

Mr. Moss considered a site at Sampalli ("A" site of the Geologist's report, Appendix III) and reports the rock not quite so good as that at the Neringipet site "and adds a dam at this site would have to be quite as big as the one now proposed "and owing to its situation its construction would be much more expensive."

As regards the rock, the Geologist's report bears out the correctness of this view as he condemns the geological structure of the rocks on the "A" site.

As regards the situation, it is seven miles further from a railway station than Neringipet site. This would involve extra expense.

The dam contemplated by Mr. Moss was of capacity 40,000 mills. cubic feet and for this capacity the surplusing saddle used in connection with the site now proposed would not have been operative. On the whole it appears that for the capacity and location of irrigated areas then proposed the Neringipet site was the best, but for the project now put forward it is inferior to the site chosen for the following reasons :—

(*a*) For a dam of similar profile and general depth of foundations below visible rock level the quantity of masonry is greater for this than for the Metur site by 14 per cent.

(*b*) There are no facilities for passing river flow except through sluices in the main dam as proposed by Mr. Moss.

(ii) *The Urachi site.*—This is three miles above Bhavāni and is clearly shown both in plan and section as "Urachikottai" in the geological report on sites (Appendix III) as well as on the project index map. The site is condemned chiefly on the Geologist's report, the character of the rocks available for foundations being very inferior to that at the other sites considered. The site has certain great advantages in giving much greater capacity for the same height of dam above the river bed level, giving facilities for surplus, clear of the main dam, and being easily accessible. The quantity of material required for a dam in this site cannot be closely estimated as there is great uncertainty regarding the depth of foundations below rock surface. From a very rough estimate with foundations 30 feet below rock level in the deepest part of the dam, it appeared that the quantity of material would be about the same as for the site chosen.

The risks of having to go much deeper and of difficulties which would only be revealed on opening out the whole foundation trenches are much greater for this site than for the sites on the gneisses and charnockites higher up the river and the site is therefore considered decidedly inferior to that chosen.

(iii) *Navapet site.*—This is $1\frac{1}{2}$ miles above Mr. Moss' site and was suggested as a possible one.

A few pits were dug and a plan and section taken.

The sight might be favourable one for a dam of a reservoir of much smaller capacity than is required but is unsuitable for what is here required.

(iv) *Sampalli sites.*—These are grouped into a series of four sites (A, B, C, D of the geological report).

Of these, only B, C and D need be considered as the Geologist's report disposes of A which has nothing to recommend it compared with the others. B and C have a common right flank, but C takes a course more downstream than B and is undoubtedly the better line.

The right end of the line runs through the hamlet Kullavarampatti and up the spur, on which the hamlet stands and the line runs at a magnetic bearing 313c and crosses the Bhavāni-Cauveripuram road at 26 miles 6 furlongs 575 feet.

The line is geologically slightly inferior to that of the site chosen. A rough comparative statement of quantities for a solid dam here and at site D (the chosen site) just below gives for site C an excess of masonry of 5 per cent for straight gravity dam over a similar dam at site D.

The general facilities for construction are also somewhat in favour of site D which has been chosen as the best site both on geological and engineering grounds and is named the "Metur site".

67. *Description of the site of the reservoir and dam and head work—The Metur site.*—The site selected for the dam across the Cauvery is just above the small village of Metur (right side of Cauvery). Here the river is about 900 feet wide.

The site is 35 miles above Erode and 24 miles above Bhavāni, the confluence of the Cauvery and Bhavāni rivers.

On the left side the steep slope of the "Chetamalais" (a range of hills) runs down into the deep bed of the river. On these hills the left flank of the dam rests on a steep scarp of rock to which the name "Benton's Bluff" has been given in commemoration of the inspection of the site in January 1909 by the present Inspector-General of Irrigation.

On the right of the river a stretch of sloping alluvial land some 3,000 feet wide intervenes between the river margin and the outlying spurs of the main hills (the Palamalais) on which the right flank of the dam rests.

Two hillocks of rock protrude from this alluvial belt (Smith's Knoll and Campbell's Hill) and these are made use of in locating the exact position of the dam, as is also the outlying spur of the Palamalais (Stoney's Ridge) on which the right section of the dam is to be built. This site and the other sites considered have been examined by a Geologist whose report (Appendix III) gives this (site D of the Geologist's report) as the most favourable from a geological point of view.

68. *Rocks in the river bed.*—At the time of this officer's examination the river was in flood and he could only examine specimens of rock from the river bed and not the rocks of the bed *in situ*. The subsequent examination of the river bed made during the dry season has shown that hard rock is exposed almost all the way across. The exposed rock is either gneiss or charnockite (a species of granite) and thoroughly sound, hard and fit to build on. There are numerous surface cracks and fissures and provision is made for cutting a foundation out in this hard rock to a general depth of about 14 feet below the rock level. In view of the thoroughly sound character of the surface rock in the river bed, it is hoped that so much excavation will not be necessary, but it is considered prudent to make such provision. In the left centre of the river bed, the rock level suddenly falls some 13 or 14 feet leaving a gully of this depth some 200 feet wide. This was covered with a layer of sand. The rock levels here have been located by probing with a pointed steel rod.

To verify these indications and make sure the hard substance found by probing was not boulders or shingle, four wells were sunk in the river bed. The rock (charnockite) was found *in situ* in each case and proved very hard and sound. The level of the rock surface in this rift goes down to levels varying from + 605 to 609. The deepest foundation level of the dam provided for is + 592, but it is believed it will be found unnecessary to go so deep.

A trap dyke, mentioned in the Geologist's report as noticed on the left side below the dam site, runs across the river diagonally, but on getting half way across splits up and dissipates itself in a number of narrow streaks through the other rock and is not found on the line of dam.

69. *Rocks in the vicinity of the site.*—The hills on the right side of the river (the Palamalais) are "charnockite", while the hills on the left side (the Chetamalais) are mostly "gneiss".

Between these ranges there are alternating bands of gneiss and charnockite. "Smith's Knoll" and "Campbell Hill" are charnockite.

In the depression to the right of Campbell Hill there is a band of "hornblende schist".

The excavations made took the form of trenches (shown on the site plan) and were taken down to a depth where the rock was so hard it could not be removed without blasting. This is the "rock level" given on the plan and sections.

70. *Favourable features of the site.*—The site is a very favourable one for diverting the ordinary flow and floods of the river clear of the main dam.

The surplusing saddle called "Ellis' saddle" is on the left side of the river and half a mile above the dam site. It is of suitable length and height for surplusing the whole ordinary flow of the Cauvery over the Chetamalais into the adjoining valley.

The water rejoins the Cauvery about two miles below the dam.

On this saddle the main surplus sluices are to be built and these supplemented by the supply sluices give sufficient discharging capacity for the maximum floods of the river.

All ordinary floods can be discharged through the main surplus sluices alone.

71. *The main dam.*—The dam proposed is to be built of random rubble masonry in hydraulic mortar. It is designed of the gravity type throughout. Provision is made for a cart road over the top of the dam which will be continued along the side of the Chetamalai Hill to the main surplus sluices. Over these sluices a road bridge is also carried, the whole constituting a bridge across the Cauvery.

It is possible that it may be found more convenient to build a bridge across the Cauvery just below the dam site for use during construction, and in such a case the road over the top of the dam would not be constructed.

The total length of the dam proposed is 6,352 feet and the quantity of masonry about 38½ millions cubic feet. The features of the site naturally divide the dam into three sections, viz ,—

(*a*) The deep section (2,021 feet) (building sections I and II) across the main river from the left flank to Smith's Knoll.

(*b*) The middle section (building section III) (1,995 feet) from Smith's Knoll to Campbell Hill.

(*c*) The right section (2,340 feet) (building sections IV, V, VI) runs along the top of Campbell Hill, then turns west across a hollow and runs on the right flank over Stoney's Ridge.

The deep and middle sections are built in a curved form in plan, each being a horizontal arch of 4,000 feet radius meeting in "Smith's Knoll" which constitutes a pier.

The right section is built in three straight lengths and in these are placed the right (high level) and central (medium level) supply sluices, both discharging directly naturally into the Cauvery through the Thukanampatti nullah.

The "deep supply sluices" are located at the right end of the middle section.

72. *Arrangements for supply of irrigation water from the reservoir.*—When the reservoir is full or nearly full, supply for irrigation will be generally passed through the main surplus sluices.

As the water falls in the reservoir, supplies will be passed successively through three sets of supply sluices built in the main dam at varying levels.

Construction sluices at a low level are provided for in the main dam; these will be used in the earliest stages of irrigation for supply as well as construction purposes. The sluices will be built up before the dam is completed.

73. *List of levels in connexion with the main dam.*—A few levels in connexion with the main dam as estimated for are noted below:—

Deepest rock level in river-bed	605
Normal deepest level of river-bed (sand overlying rock of previous item)	616
Average level of river-bed	619 to 624
Level of low water surface flow at site	621
Lowest level of dam foundation as per estimate	592
Full level of reservoir...	785
Level of road surface	794
Top of parapet	798
Level of maximum water for stability calculation	788
Level of cill—	
Deep supply sluices	678
Central	730
Right	745
Construction sluices	624
Level of cill main surplus sluices on saddle	771

74. *Flood discharge of Cauvery at Metur and surplusing capacity required for the reservoir.*—The gauging of the Cauvery taken last year (1909) in the Cauvery at the Cauvery dam and near Bhavani (and described in Volume III) have given reliable information for graduating gauges and computing discharges up to levels of moderate floods. No really high floods occurred during the year and thus, to compute discharges of abnormal floods, it is necessary to prolong curves and make assumptions which give results possibly, and not improbably, below the true discharges of very high floods.

The computations made by Mr. Moss for the maximum flood discharge to be dealt with at Neringipet (7 miles below Metur) are given in his report (Appendix to G.O. No. 971 I. of 2nd September 1904), page 124, and as a result 250,000 cusecs discharge was provided for in that officer's scheme.

The gauge readings (now available) at Bhavani bridge in the Cauvery were not then made use of and the maximum flood discharge was computed from the recorded floods at the Upper Anicut (Cauvery dam). The maximum flood recorded at the Upper Anicut is 14 ft. on the Cauvery dam gauge on 31st July 1896.

This discharge was taken by Mr. Moss as 313,000 cusecs from the discharge curve drawn by Major Montgomerie (plotted with curves of Volume III).

The revised curve of the discharge at Cauvery dam drawn this year from the results of gaugings give results materially smaller, being 266,000 cusecs at this level. The combined flow of the tributary rivers Bhavani, Amaravati and Noyel at the time of the flood is recorded as 33,286 cusecs. Deducting these, there is a balance (266,000—33,286), say 233,000 cusecs for the combined surface flow from local catchments between Bhavani and the Upper Anicut and the flow of Cauvery at Bhavani bridge.

Mr. Moss assumed that the local catchments (area 2,370 square miles) might be counted to have discharged 30,000 cusecs. It is considered that this is excessive having in view that there was not heavy local rain at the time. This item, to be on the safe side, may be neglected and this leaves a balance 2,33,000 cusecs as the flow at Bhavani bridge of the Cauvery.

The curve of the discharges of 1909 gives 207,000 cusecs for the gauge reading recorded at Bhavani bridge for this flood, but it is not improbable that this may err to the extent indicated by the above discrepancy. It is, however, considered absolutely safe to take 250,000 cusecs as the outside possible discharge due to such floods, viz., the gauge reading Bhavani bridge of 18·25. In the 28 years for which we have daily readings of the gauge at Bhavani bridge (1882 to 1909) this is the only occasion on which over 18 feet is recorded. On one occasion 17·5 is recorded, viz., 23rd July 1882.

At the Cauvery dam 13·25 is the second highest recorded reading in November 1858. This was due to combined discharges of the Cauvery and the large tributary rivers and heavy local rains. The next highest flood is almost the same gauge reading 13·1 feet on 23rd July 1882 which corresponds to the second highest recorded flood at Bhavani. The fourth highest flood at Upper Anicut is 13 feet on 11th October 1887, which corresponds with a 17 feet flood at Bhavani of 10th October. The records of the floods at Cauvery dam (Upper Anicut) shew us that we are justified in accepting the flood of 1896 as the largest since 1858 *both* at the Upper Anicut and on the Cauvery at Bhavani bridge.

Further, it is safe to conclude that this flood certainly did not exceed 250,000 cusecs and is probably not more than 233,000 cusecs. The catchment area of Cauvery at the dam site is 15,700 square miles and 26,172 square miles at the Upper Anicut (Cauvery dam). The co-efficient in Ryves' formula giving a discharge of 250,000 for this catchment area at the dam site (27 miles above Bhavani bridge) is 398·7.

The question is, if, considering this co-efficient and considering also that there is the certain knowledge that in 50 years no flood exceeding 250,000 cusecs has passed, it is justifiable to fix this as the surplusing capacity of the large reservoir.

In settling this it is proper to consider what would happen if this computation of maximum flood prove too little. A rise of 3 feet above full reservoir level would increase the discharging capacity of the main surplus sluice by 40,000 cusecs or 16 per cent.

A rise of 4 feet by 60,000 cusecs or 24 per cent.

No serious inconvenience or danger would be entailed by such rises taking place.

Under the circumstances, it is considered that the surplus arrangements which provide for a discharge of 250,000 cusecs are quite adequate and may be accepted as safe with absolute confidence.

Supply sluices in the main dam.—It will be convenient in describing surplus sluices to describe also the arrangements of "supply" and "construction" sluices provided in the main dam. Some of these are used as surplus works.

The supply sluices proposed are—

(*a*) *Deep supply sluices.—Fourteen vents of 6 ft.* × 12 *ft. cill* + 678. Deep supply sluices situated east of Campbell Hill and delivering water into Thukanampatti Nullah through a channel cut along the side of the above hill and kept in bounds on its left side by a suitable bank and retaining wall. These sluices consist of 14 vents of 6 ft. × 12 ft. with cill at + 678. The discharge of these sluices with water at + 700 is computed at 19,348 cusecs.

Below level + 700 it is counted that the capacity of the reservoir is not fully effective. The capacity at + 700 is 10,000 M.C. ft.; at cill level (+ 678) the capacity is 3,800 M.C. ft. These sluices are not to be used as surplus works when the reservoir is complete but will be so as during construction.

(*b*) *Central supply sluices.—Sixteen vents of 6 ft.* × 25 *ft., cill* + 730. These are placed on the rock hillock named "Campbell's Hill" and surplus over this into the hollow between it and the outlying spurs of the main hills. The water from here runs naturally into the Cauvery through Thukanampatti nullah.

The sluices consist of 16 openings of 6 ft. × 53 ft. with cill at + 730.

These sluices can pass 20,000 cusecs when water level in the reservoir is + 748. They are given a height additional to what is required for supply as being cheap and efficient surplus works. The sluices will be used for supply purposes with water in the reservoir between cill level (+ 730) and + 760.

The surplus discharge capacity of these sluices (reservoir full) is computed at 75,104 cusecs. They will be used as surplus sluices only when they are required to supplement the main surplus works on the surplusing saddle and the right supply sluices, that is, when water to be surplused exceeds about 170,000 cusecs.

(*c*) *Right supply sluices.—Eight vents of* 16 *ft.* + 16 *ft. cill* + 745. These sluices are placed in a dip in the rocky spur running out from the main hills on the right of the dam which has been named "Stoney's Ridge". They consist of eight

openings of 16 ft. × 16 ft. with cill at + 745. These sluices can pass 20,000 cusecs with a level in reservoir + 760 and will be solely used for passing irrigation supply with level above + 760 and below + 771, the cill level of the main surplus sluices; used as surplus sluices, the discharge capacity of the right supply sluices (reservoir full) is computed at 57,917 cusecs.

(*d*) *Construction sluices—Six of 6 ft.* × 12 *ft. cill* + 624.—These sluices are required as their name denotes for surplusing water during the dry season, while the building of the deep section of the main dam over the river-bed is being carried out.

These sluices are also to be used for irrigation supply in the early stages of the work when extension of irrigation is commenced under the incomplete reservoir. The number proposed is six sluices of the same pattern and dimensions as used for the deep supply sluices, viz., 6 ft. × 12 ft. The cill level to be + 624 or about 3 ft. above the lowest water level in the Cauvery river. These sluices can pass 10,000 cusecs with water above them at level + 656 at which level the impounding capacity of the reservoir is 1,000 mills. c.ft. In the programme for execution of work the level of the main dam (section No I) is raised from 652 to 672 in the sixth dry season and new irrigation commences from this year. The level of the river present margins is 650 to 654. The working capacity of the construction sluices in passing water during the dry season in the interests of the building construction is noted on elsewhere.

76. *Necessary capacity of supply sluices.*—In considering the necessary discharging capacity of the permanent 'supply' sluices 20,000 cusecs has been taken as a suitable figure representing full supply, at a duty of 68 acres per cusec, to 1½ million acres which is the maximum area of crop which will ever be on the ground simultaneously. For the supply from the "construction sluices", which are only intended to assist in developing the new cultivation, about one-half this is considered a suitable *supply* capacity.

77. *Main surplus sluices.*—The main surplus sluices are to be built on a saddle on the left side of the Cauvery half a mile above the dam.

The top of the saddle has to be excavated as provided for to give suitable approach and run-off surfaces for the surplus sluices.

The discharge is over the saddle into the "Thottilpatti Vari" and back into the Cauvery two miles below the dam. The main surplus sluices are designed in two sets separated by a rock knoll on the saddle.

The right sluices, 13 spans of 40 feet.

The left sluices, 6 spans of 40 feet.

The cill level is + 771.

The maximum water level in reservoir + 785. The top of the sluice shutters + 786. The shutters are designed to lift 4 feet clear of the water level to allow trees and drift to pass without obstruction in flood time.

The shutters to be of the same general design as has been applied to the Periyar Reservoir surplus sluices.

A cart road, 10 feet in the clear, is carried over the piers on the down stream side of the gear platform.

The discharge through the sluices with the reservoir full and shutters lifted clear is computed at 6,320 cusecs per span or a total 120,080 cusecs which roughly corresponds to a gauge reading of 13 feet on the Bhavani bridge gauge. Referring to the statement of highest gauge readings, we see that in the last twenty-eight years these sluices would have been sufficient to pass the whole flow of the Cauvery except on the following occasions :—

17 days,	July	1882	13 days	July-August	1900	Total days—66 in twenty-eight years.
1 day	,,	1883	5 ,,	July	1902	
1 ,,	August	1884	4 ,,	July-August	1903	
4 days,	July	1892	3 ,,	July	1904	
8 ,,	July-August	1896	3 ,,	August	1907	
7 ,,	August	1897				

78. *Total surplusing capacity, surplus works.*—Abstract showing total surplusing power of sluices proposed for the Cauvery Reservoir at Metur—

Into Thottilpatti Valley.	CUSECS.
Main surplus sluices on surplusing saddle	120,080
Into Thukanampatti Nullah.	
Right supply sluices	57,917
Central supply sluices	75,104
	133,021
Total ...	253,101

79. *Number of workmen.*—The computation of time required for the work is grounded on the assumption that 580 masons will be constantly employed, and with them the subsidiary labour of quarry-men, and coolies for the supply of material. The men will bring their families and settle down on the works and it may be counted that there will be some 10,000 to 12,000 persons connected with the works in the vicinity.

Special provision is made under sanitation for the constant employment of a Medical and Sanitary Officer with two assistants.

A Sub-Magistrate, Police Inspector and staff of constables are also provided for in the estimate.

The greatest difficulties of the work will be those connected with adequate and constant supply of labour and the large sums provided for housing, water-supply and sanitation, if they ensure comfort and health to the workmen and their families, will be fully recouped in rapid and systematic progress of works. The expenditure of time on preliminary arrangements—water-works, housing, communications, etc.,—does not entail cost other than the actual capital cost of these works and the interest on them.

The cessation or serious check of works for a single dry season after large sums of money have been expended is likely to entail more loss in interest charges than all the capital expenditure proposed on housing and sanitation.

Adequate time and adequate money for good preliminary arrangements are therefore very essential. On these will depend the success and progress of all the subsequent work.

80. *Housing of workmen and sanitation.*—Provision is made in the estimate for housing all labour, and for a staff for the thorough sanitary supervision of the labour camps and the whole locality of the works.

At certain times of the year cholera (river-borne) is rife and a piped supply of filtered drinking water is an essential, and such supply must be available in the residential camps and also on the works.

Precautions on the works will be necessary to ensure that the workmen do not drink the unfiltered supply of water which must be available in large quantity for the masonry.

81. *General healthiness of the vicinity of the head works.*—Enquiries regarding this were made from the Roman Catholic Missionary of Metur, who states that the immediate locality is healthy and not subject to fever. The surveyors and others employed on the investigation did not suffer severely from fever but did so occasionally, and the villagers of Metur are said not to suffer from fever.

Higher up the river above Sampalli the tracts, especially in the vicinity of Cauveripuram and up to Hogankal, are stated to be very feverish. Lower down near Pudur there used to be a church and mission station (Roman Catholic), which has been abandoned, it is stated, on account of the unhealthiness of the place.

From the positive evidence of subordinates living and officers visiting Metur, there is no reason for thinking the place unhealthy : at the same time, the vicinity of feverish localities emphasise the necessity for the most careful sanitary arrangements.

The place shut in, as it is between hills, is very hot in the hot season.

82. *Location of buildings, camps and residences.*—The location of buildings, etc., is a matter which must be decided by the officer who is entrusted with the execution of the scheme and must be made to fit in with arrangements of communications, roads and tramways.

Locations considered generally suitable are here indicated—

Main lines for workmen.—South of Thukanampatti vari and between the village of that name and the hills.

Lines for artificers and Lower Subordinate Works establishment.—South of the above lines between the road and the hills between furlongs 25/1 and 25/3 road mileage.

Hospital and sanitary staff.—Between road and river about 25/3 road mileage.

Public Works Department Upper Subordinates, clerks, draftsmen.—West of road between road and hill between 24/7 and 25/1.

Officers' bungalows.—South of Pudur vari between road and hills.

The objection to this arrangement is that the officers and subordinates are from 1 to 1½ miles from the work site.

An alternative is to have the workmen and hospital east of the Chetamalais in the Thottilpatti valley with a road over these hills and a bridge below the dam site. The officers' quarters and offices would then be moved up close to Thukanampatti.

The power-house, workshops and main stores should be north and west of Metur village close to the dam site and just below the run-off channel from the deep supply sluices.

Water-supply must be worked out when the location of camp is decided on. There are advantages in having the off-take on the left of the river where steep ground runs close along the margin, and thus the limits of water-spread does not alter very greatly in horizontal direction as the water-levels rise and fall.

The supply of drinking water must, as before mentioned, be filtered as the river water not infrequently is contaminated with cholera germs. Jewell filters are suggested as probably the most suitable.

83. *Special plant and mechanical power.*—It is proposed to freely make use of mechanical power and appliances for carrying out the work.

For all purposes, except locomotion, it is proposed to distribute power to machines electrically from a Central station which it is proposed to establish below the dam site between it and Metur village to the west of the road.

Provision is made for generating here up to 300 kilowatts. This power will be distributed by overhead lines on continuous current system all over the works and will actuate—

Pumps.	Disintegrators,
Cranes.	Concrete mixers.
Compressers for quarry plant.	Lighting plant.
Mortar mills.	Filters.
Stone crushers.	

Should concrete construction be adopted for the bulk of the masonry, additional power and plant will be necessary and provision is made for this alternative.

84. *Fuel for power production.*—It is proposed to develop the power by oil-engines, as it is believed the supply of wood from the forests for lime and surki burning will sufficiently tax the labour resources without depending on wood fuel for power.

85. *Local transport and communications.*—A regular transport service must be organised from "Erode," the most convenient railway station, distant 35 miles from Metur.

For this, provision is made in the estimate for heavy motor (steam or oil) road lorries or traction engines.

Provision is also made for building several small bridges and culverts and improving and upkeeping the existing metalled road throughout the period of construction.

For transport in the vicinity of the works from quarries and lime fields, etc., to the dam site an extensive system of light railway 30-inch gauge is proposed and small steam locomotives are provided for haulage from quarries and lime fields to the immediate vicinity of the work.

On the masonry of the dam throughout its length, light rails which will be shifted as required, will be maintained and cranes at suitable stations will transfer loaded truck bodies from the surface lines to the lines laid on the body of the work.

For transport by water of fuel and sand from the upper reaches of the river two steam launches and 25 steel barges are provided. These will be largely supplemented by carriage in the local leather boats in which a large traffic in manure plants between Cauveripuram and Bhavani is now carried.

86. *Telpher system of wire rope ways.*--A proposal has been made to instal the Telpher system of wire rope conveyance of material on the dam and this would probably be a better arrangement if concrete is substituted for rubble hearting as the main item of masonry--that is, if labour difficulties as regards supply of masons are found to be excessive. The extra cost of this system as compared with that proposed has been roughly estimated for and is included in the extra cost of plant which will be required if the dam is built of concrete.

The "Telpher" machine is practically an electric traveller with hoisting gear. It is operated by a driver seated in each traveller and runs on an overhead system of steel wire ropes, the power being picked up by a travelling arm from a separate power wire.

The load is picked-up by a hoisting rope from the "Telpher" machine and carried suspended in mid air to the position where it is required when it is lowered.

87. *Sea and Railway transport.*--Erode will be the railway station on which the works will depend. The road from Erode to the dam site runs all the way close along the Cauvery right side to the dam site. Erode is the junction of the broad and narrow gauge sections of the South Indian Railway. It is 243 miles broad gauge from Madras and 167 miles narrow gauge from Negapatam.

It is proposed that Negapatam in the Tanjore district shall be the sea port at which the bulk of the stores imported for the project works shall be landed. The railway from these directly serves not only the headworks but all the distribution system as well.

B.—Technical.

88. *Surveys and survey marks and datum of levels.*—The datum level for the survey is the same as in Mr. Moss's project, in which the datum of the levels is stated to be G.T.S. *Mean Sea Level.* This has not been verified by check level to the nearest G.T.S. bench mark (at Erode). A list of survey marks and bench marks will be found in Volume II.

89. *Plans.*—The following surveys and plans in one roll and one portfolio (No. 1) are submitted with the estimates for the head works :—

List of plans.

	Plan number.
Waterspread area, two sheets	H 1 (*a*) and H 1 (*b*)
Site survey, head works	H 2
Do. enlarged dam site	H 3
Longitudinal section, dam site	H 4
Profile of dam	H 5
Construction sluices...	H 6–7
Buttress No. I	H 8
Deep supply sluices	H 9–10
Section of "Run-off" channel from deep supply sluices ...	H 11
Central supply sluices	H 12
Right supply sluices	H 13
Site survey main surplus sluices	H 14
Cross-sections of site main surplus sluices	H 15–16
Main surplus sluices	H 17–18
Survey of river bed in vicinity of dam site	H 19

90. *Remarks on designs for the Main dam—Preliminary studies on design of masonry dams.*—As a preliminary to the design of this dam, an Engineer officer (Mr. R. A. Ryves, A.M.I.C.E.) was employed making studies of the subject of masonry dams with special reference to the proposed works in the Madras Presidency.

This officer has drawn up an able and instructive note on the subject (*vide* Circular No. 753 of 14th June 1910).

In this note it is clearly brought forward that as regards gravity dams the proposed work is unprecedented, in that in this case, great length is combined with height above foundations to an extent greatly beyond any work in existence. There are instances of existing dams of much greater height, but in every such case the length in which the height of dam exceeds 150 feet is small (under 400 feet). While such dams (when built as gravity dams) have been designed on the data generally accepted for such designs, there is nothing to prove that in the deep narrow gorges forming the deep sections of these structures, the stresses are developed on the lines of the data assumed for calculation. It is quite possible, and indeed most probable, that such structures in their deep sections get great support by arch action, the abutments being the sides of the narrow gorge in which they are built. In the case of the Cauvery dam such support cannot be exerted except for a short length where the dam is its deepest. There is a great and altogether unprecedented length of dam in the deep (left) section standing over 150 feet above its foundations, and also above the level of surface rock, and for this length we cannot claim that the experience of previous works justifies acceptance of the data of computation used for existing works on the ground of the successful construction and stability realised by these.

91. *Safe limits of normal data of design of dams.*—The normal data on which gravity dams are designed has been the subject lately of much discussion among Engineers and from these discussions it is clear that it cannot be claimed that the data of design generally used are accurate.

It can be claimed, however, that no dam fulfilling these conditions and constructed of sound material and work on sound foundations has ever shown signs of weakness. When fairly comparable with existing structures, normal data of design may therefore be taken as quite safe and are in general use.

92. *Dr. Unwin's computation for maximum stress in a dam.*—In the late discussions in the Institute of Civil Engineers (Proceedings Volume CLXXII) it was brought forward by Dr. Unwin that the maximum stresses developed on the outer face of a dam as compared with the vertical component of stresses varies with the angle of the face to the vertical in proportion of the secant squared of this angle. This proposition, it is considered, must be admitted. On the normal data of design the greatest vertical stresses are at the face.

It is however fairly well established that in high dams of normal type the maximum vertical pressure on the base is not at the extreme downstream face with the reservoir full but what the distribution of the pressure is is at present indeterminate.

It probably varies with the angle of the downstream face of the work.

93. *Note by Mr. R. A. Ryves—Limit of pressures, downstream face and methods of computation.*—The question of distribution of pressures and data of design is discussed in Mr. Ryves' note and the proposal made by him in submitting the note was that, as the distribution of pressure was indeterminate, and as the nature of works was such that we cannot look to precedent and quote existing works to justify the computation on the ordinary data, it is necessary to exercise great caution.

The system which was recommended for computation of stresses was that of M. Bouvier:

In this the distribution of stress over the base is assumed to change uniformly from a minimum on one face to a maximum on the other and the maximum stress is computed to be the vertical component of resultant pressure multiplied by the square of the secant of the angle, the direction of the resultant of the pressures on the base makes with the vertical.

94. *Data adopted for computation of stresses, downstream face.*—The recommendation of Mr. Ryves was accepted by the writer subject to the further proviso that the dam should be so designed that the maximum limit of stress fixed on should not be exceeded by more than 50 per cent when computed according to Dr. Unwin's proposition and on the usual assumption that the maximum component of vertical stress is at the downstream face of the work (reservoir full).

The safe maximum stress proposed for a dam of small rubble (or concrete) in surki lime mortar of good quality was 8 tons per square foot (Bouvier) and this involves a limit of 12 tons per square foot (Unwin) under the above proviso.

95. *Description of design of profile of dam and computed stresses on the downstream face.*—For a deep dam the acceptance of the above conditions involves the abandoning for the lower layers, the normal type of profile which type gives from depths exceeding about 155 feet below water level slopes to the downstream face of the work too flat to fulfil the limiting conditions as to stress (Unwin) laid down.

The profile of the proposed dam has not been arrived at in the deeper portions by the methods described by Wegmann and other writers, as the condition imposed by consideration of stresses dependent on the slope of downstream face of the dam introduces a new factor.

The profile adopted has been arrived at by trial. After many types were investigated, a limiting angle with the vertical for the downstream face of the dam of 43°—32′ (slope 19 horizontal to 20 vertical) has been adopted as the most suitable in view of economy and limit of stress.

This limit to the downstream face slope entails increase of the amount and width of masonry projecting upstream of the top front face of the dam and the distribution of masonry below level + 650 (138 feet below maximum water surface) differs from that which would obtain were the downstream slope not limited as above. It is with considerable surprise that it is found that this change in shape of profile does not entail extra masonry, where (as in the profile now proposed) the limit of

NOTE:- AVERAGE QUANTITY OF MASONRY IN THE BRIDGE PER FOOT RUN OF DAM = 107· CUBIC FT.

CAUVERY RESERVOIR PROJECT

PROFILE OF MAIN DAM WITH COMPUTED STRESSES

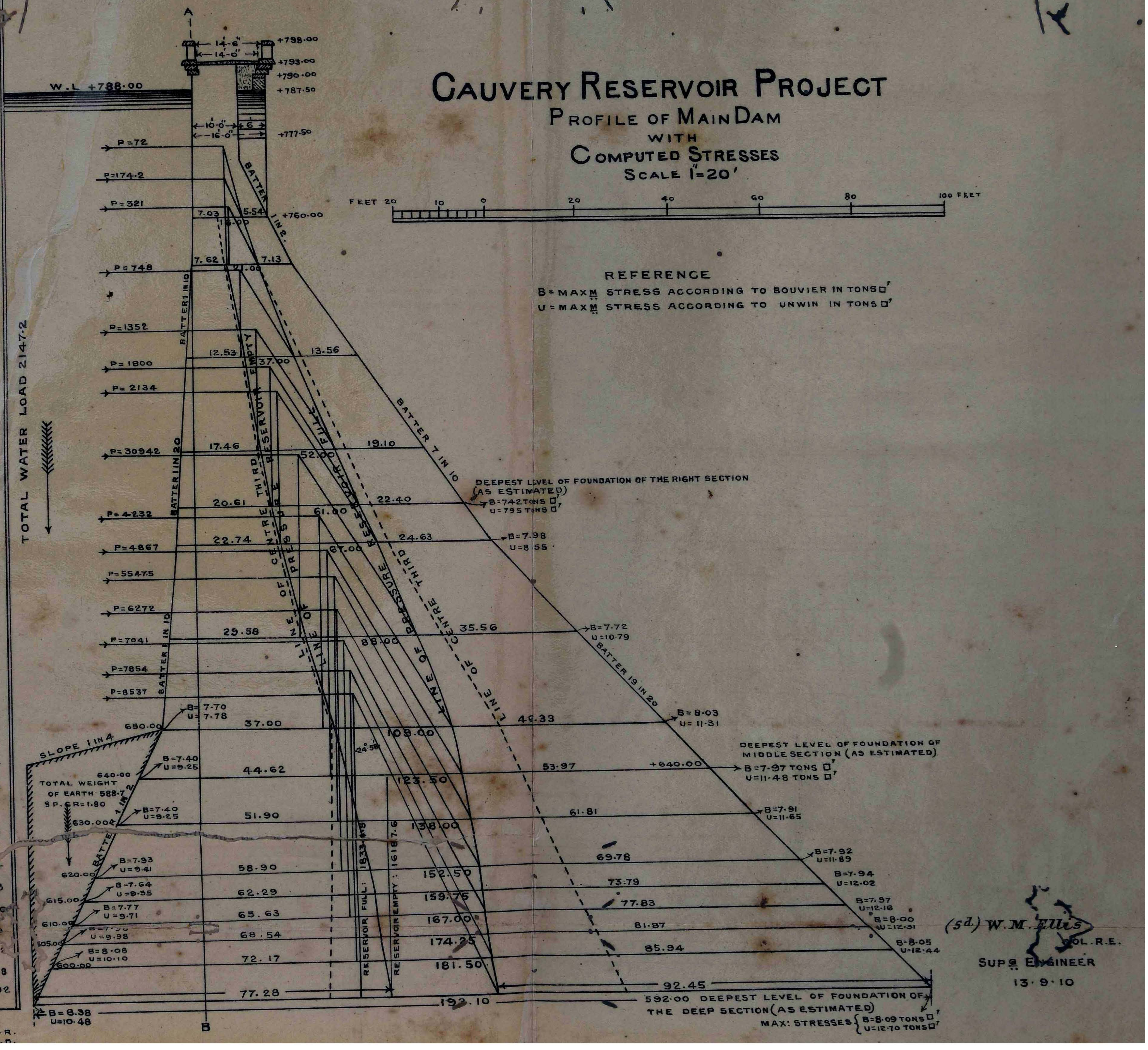
SCALE 1" = 20'

REFERENCE

B = MAXM. STRESS ACCORDING TO BOUVIER IN TONS □'

U = MAXM. STRESS ACCORDING TO UNWIN IN TONS □'

LEVELS	QUANTITY OF MASONRY CUBIC PER FOOT RUN OF DAM EXCLUSIVE OF BRIDGE, PARAPETS, &c.
+788·00	50
785·00	80
780·00	130
775·00	180
770·00	231
765·00	292
760·00	366
755·00	452
750·00	551
745·00	665
740·00	801
735·00	956
730·00	1131
725·00	1325
720·00	1539
715·00	1770
710·00	2021
705·00	2290
700·00	2579
695·00	2885
690·00	3211
685·00	3559
680·00	3934
675·00	4334
670·00	4761
665·00	5214
660·00	5694
655·00	6199
650·00	6731
645·00	7294
640·00	7894
635·00	8529
630·00	9201
625·00	9909
620·00	10654
615·00	11433
610·00	12250
[illegible]	[illegible]103
600·00	1399[illegible]
595·00	14918
592·00	15492



(Sd.) W. M. Ellis COL. R.E.
SUPG. ENGINEER
13·9·10

TRACED BY P·R·R.
COMPARED BY G·D.

computed maximum stress (Unwin) is permitted to rise slightly over the 12 tons limit in levels below + 615 (the general level of rock in the river bed is from + 621 to 624). The table which follows shows the maximum stresses at each level below + 630 on the downstream face, reservoir full and on the upstream face reservoir empty. For purposes of calculations the maximum water level has been taken as 3 feet above the level of the full reservoir as designed.

Maximum stress in tons per square foot (reservoir full).				Maximum stress in tons per square foot (reservoir empty).	
Level.	Vertical.	Bouvier.	Unwin.	Vertical.	Unwin.
630	6.13	7.91	11 65	7·40	9·25
620	6 26	7·92	11·89	7·53	9·41
615	6·32	7·94	12·02	7·64	9·55
610	6·40	7·97	12·16	7·77	9 71
605	6·48	8·10	12·31	7·92	9·91
600	6·55	8·05	12·44	8 08	10
592	6 69	8 09	12·70	8·38	10·10 ·48

Below + 605 the masonry is all in a narrow rift in the river bed rock and will receive support from arch action and the stresses developed are within safe limits as shown by precedent of existing works.

The design provides for filling with earth in the upstream side of the dam to a level + 650 at the dam and sloping the top of the filling at 1 in 4.

The weight both of this earth (sp. gr. 1·8) and of the water (reservoir full) resting on the sloping upstream face of the dam has been allowed for in the stability calculations and these factors have an important bearing on the combined directions and intensity of resultant stresses.

The earth filling provided is a feature common in modern dams.

It reduces the water pressure on the deepest part of the dam, covers the junction between the upstream toe of the masonry and the foundation, and guards the rock and masonry in this part from excessive temperature changes.

In calculation no reduction in water thrust has been allowed for on account of this earth filling but on the other hand nothing has been allowed for the horizontal thrust of the earth against the face of the dam.

96. *Computed pressure on upstream face of dam.*—The maximum pressure computed reservoir empty is shown in the table in last paragraph as 8·38 tons (Bouvier) and 10·48 (Unwin).

This is considered well within the limit of safety.

Further it may be noted that after the closure of the construction sluices the reservoir will never be empty and further the thrust of the earth filling and silt deposited against on the upstream face of the work will relieve pressure and as a fact pressure on the upstream toe will never exceed 8 tons (Bouvier).

It may be mentioned here that maximum pressure on the piers of the deep supply sluices reservoir empty is computed at 10 tons per square foot and for this reason provision is made for building all of these piers upstream of the grooves in Portland cement mortar.

97. *Arching the dam.*—It will be seen from the plans that the left and central sections of the dam are arched in plan, each arch with a radius of mean length 4,000 feet. The calculations in Volume II show the maximum stresses in the masonry which could be induced by arch action brought into operation by the natural tendency of the structure to deflect when the reservoir fills and the water pressure comes on the dam.

Two buttresses are provided, one where both arches meet on Smith's Knoll, and a second, in prolongation of the right of the right hand arch, on Campbell's hill. These are computed to take up all possible external arch thrusts and withstand the maximum possible thrust to which they could be subjected by arch action.

98. *Advantages of arched form.*—The arching of the dam is considered a very essential feature of the design having in view the great height and length of the work.

A straight dam in such a site will be almost sure to crack, on account of alterations in length due to variations of temperature and on account of motion under variation of load.

In the arch form increase or diminution of length due to temperature is less likely to cause cracks, while if cracks are caused, the water load will have the tendency to close these as the reservoir fills. In a straight dam this is not the case.

The quantity of masonry on the arched sections of the dam is 1 per cent extra on account of the arched form.

Further the arching lends itself to the provision of temperature joints in the dam which could not be recommended in a dam which is straight in plan. It is considered that such joints should be provided in a dam of this magnitude, with a view to preventing cracks occurring on account of initial fall of temperature after first construction, and of localising such cracks, if they should occur, into directions, and positions, in which they will not be injurious to the structure. The proposed temperature joints will effect this by forming planes of weakness along which cracks, if they occur at all, will be formed.

99. *Through joints left in dam above water level.*—Although the arched form of dam is retained above the level of full reservoir it is considered undesirable to develop arch action above this level, and to prevent this it is recommended that above level of the full reservoir (+ 785) expansion joints be introduced at intervals of (say) 200 feet along the arched lengths of the dam.

These joints may be left as open through joints closed only on the water face, or joints filled with some bituminous material, to take up in the joint any movement of the top of the dam.

This will take all arch stress off the top of the dam above water level which part is subjected to the greatest deflection movement and also to the greatest changes of temperature.

100. *Temperature changes.*—The temperature changes to which a dam is subjected may be classified into four classes—

(*a*) Temperature changes to which the masonry is exposed only during construction.

(*b*) Temperature changes of mass masonry due to seasonal changes of temperature.

(*c*) Temperature changes due to diurnal changes.

(*d*) Temperature changes at the base of the dam.

(*a*) The range of temperature change of the mass of the masonry within the first few months of being laid will be greater by far than what it will ever, considered as a mass, be subjected to again. The reasons for this are—

(1) That such layer of masonry will when being laid and for some time after, be exposed to the direct rays of the sun. Although the plentiful application of water will modify to some extent the resulting rise of temperature, yet it must still be very material.

(2) The rise of temperature due to the chemical changes taking place in the setting of the mortar will still further induce a rise of temperature.

It is considered that the masonry when first laid may rise to a temperature as high as 110° F. or more. In the cold weather when the masonry cools its temperature may fall as low as about 77° F.

This is a range of 33° F.

(*b*) After construction the mass of masonry in the heart of the dam will slowly follow but lag behind the seasonal changes of temperature.

Mr. Ryves who has written a long note on this subject has given a table of mean monthly temperatures (taken from Sir John Elliot's maps) in the locality of the proposed dam which is reproduced below :—

Tables–Degrees F.

Month.	Mean temperature	Change.	Month.	Mean temperature.	Change.
January	$77\frac{1}{2}$	...	July	85	2
February	$77\frac{1}{2}$	...	August	85	...
March	$82\frac{1}{2}$	5	September	83	2
April	86	$3\frac{1}{2}$	October	81	2
May	88	2	November	78	3
June	87	1	December	77	1

Considering that mean temperature is materially below the monthly mean of certain years, this may be set off against the "lag" and the range under (*b*) put down as from 77° to 88° or 11° F.

Taking the co-efficient of expansion of rubble masonry or concrete as = ·000006 per degree F. and the modulus of elasticity of 3 mill. lbs. per square inch, the stress required to resist expansion or contraction on change of temperature

per Degree F = ·000006 × 3,000,000
= 18 lbs. per sq. inch.
= 2,592 lbs. per sq. foot.
= $1\frac{1}{6}$ tons (nearly) per degree F.

Now masonry and concrete cannot *safely* withstand a stress of $3\frac{1}{2}$ tons per square foot in tension, a stress to which it would be exposed by a lowering change of mean temperature of 3° F., but it can safely resist 12 to 14 tons in compression. If therefore the dam be built, or what has the same effect, if the joints in the dam be keyed up, when the masonry is at a temperature within about one degree of its lowest, the greatest temperature stress to which it can be subjected will be, say, $1\frac{1}{6}$ ton per square foot in tension and 12 tons per square foot in compression for the total range of temperature *after the first setting of the mortar* and after the masonry is covered up 3 or 4 feet deep, which range is 11° F. The great range 33° F. to which the masonry of the dam will be subject during building would if the whole is built in solid and jointless cause shrinkage when the masonry cools down and this must either be taken up in a multiplicity of invisible hair cracks or by a few visible and possibly injurious cracks. The total shrinkage over in a length of 2,000 feet due to a fall of temperature of 30° F· would be

= ·000006 × 30 × 2000 × 12
= 4·3 inches.

As each arch of the Cauvery dam is about 2,000 feet long, it will be recognised that this is a serious consideration.

(*c*) The changes of diurnal temperature is great and especially on the downstream side of the dam.

The effects of this may induce cracks but these are unlikely to penetrate to any depth.

No provision against these is proposed.

(*d*) *Changes of temperature at the base of the dam.*—It is very desirable to keep the base of the dam near the rock surface and the rock of the river-bed at the same temperature and to limit the range of temperature change *especially on the upstream side.*

To effect this, a filling of earth (about 30 feet deep) over the river-bed on the upstream side of the dam is provided for.

On the downstream side after the work is complete, some filling may also be desirable, but no provision is made for this. The filling upstream will assist in reducing the water pressure on the dam and thus serves a double purpose

101. *Mr. Ryves' note on temperature changes.*—Mr. R. A. Ryves has dealt with the subject of temperature change at much greater length in a separate note especially in regard to the question of diurnal changes but is not considered desirable to go further into the matter here.

102. *Proposal for temperature joints—combined with arched form.*—In order to ensure temperature stresses being within suitable limits and to provide for and prevent cracks, it is proposed—

(i) To make the main lengths of dam curved in plan within a radius of 4,000 feet so as to adjust itself by minute changes of form to temperature variations, etc.

(ii) To leave during building "through joints" in the dam throughout each year's work at intervals of about 400 feet and build these in solid not sooner than three months after first building in the months of January or February yearly when the temperature of the masonry is at its lowest. This will secure that the effects of temperature variation will be rather to close joints and consolidate the dam than the reverse.

There joints will further be radial and will give planes of division along which any cracks due to deformation in plan are likely to be located. Cracks through such joints would not with an arched form be injurious to a dam.

103. *Location of temperature joints.*—As regards location of temperature joints it is here brought to notice that where it is necessary to build one part of the dam much higher than another, the location of such a joint where the change of level takes place will guard against cracks by uneven settlement.

It will be seen later that it is necessary to keep the surplusing section of the dam 16 to 20 feet lower than the rest of the dam. The surplusing section is 900 feet long.

This at once indicates that temperature joints may suitably be placed in the centre and at each extremity of this section (No. 1 section).

104. *Nature of masonry proposed.*—It is proposed to construct the dam of small rubble in lime surki mortar.

The stone is "charnockite" from the hills in the immediate vicinity and is eminently suited for such work. Kunkur for lime and earth for surki of excellent quality is also available in unlimited quantities.

The stone will be generally of such a size that one man can handle a stone without great effort, say, of average weight of about 60 lbs. The stone will be laid as it comes from the quarry without shaping.

On the faces for an average thickness of two feet the stones will be carefully laid to fit and joint with adjacent stones being shaped with the hammer.

The general character of the face masonry will be the same as the hearting, viz., small random rubble.

Frequent bond stones not less than two and a half feet long will be used in the facing.

105. *Concrete alternative to rubble masonry.*—Random rubble is considered the best material for the construction of the dam and is thus provided for. Should it be found impossible to get the number of masons or other labour required for such construction, it may be necessary to substitute concrete hearting wholly or in part for the rubble proposed.

The cost of concrete will be about the same as that as rubble, exclusive of the capital cost of the machines for handling it, but the advantage to be derived from its use is the practicability of doing much of the work by mechanical appliances should the supply of labour fail.

While it is believed and hoped that the extensive substitution of concrete for rubble will not be necessary, it is considered prudent to make provision for plant for making ⅔ of the mass of the dam of concrete should the progress be such as to make this desirable.

A few crushers and concrete mixers will be installed with the original mechanical plant but it is only proposed to get the bulk of the concrete plant provided for, should labour difficulties prove that this course is necessary for rapid execution of the work.

106. *Linings of supply and construction sluices.*—The lining of the floors and archwork over the sides supply sluices is proposed to be of cutstone.

For the sluices of 6 feet width, the flooring stones will be 8 feet long and 1 foot thick and span the entire width.

For the sides there will be headers and stretchers alternately, the headers being $2\frac{1}{2}$ feet long and the stretchers 1 foot wide.

For the construction sluices, the floor and top arching will be cutstone but the sides rubble "face work."

The stone will be granitic gneiss set in cement.

107. *Turbine tubes.*—Provision has been made in the estimate for four pipes 24 inches diameter being built through the dam for supply of power. No location has been fixed for these pipes and they are not shown on the plans.

These pipes will be cased in 12-inch thickness of cement concrete and built solid into the rubble of the dam. A sluice valve with a spindle red reaching to the top of the dam will be fixed on the upstream end and another sluice valve on the downstream end. A small pipe as a bye-pass provided with a valve on the downstream end will also be installed.

This arrangement gives facilities for working the large valves without any head on them and thus freeing them for work under pressure. It has been adopted for the turbine sluices on the Darna Dam (Bombay Presidency) now under construction—*vide* diagram.

108. *Temperature joints proposed.*—In paragraphs 100 to 103 above referring to temperature effects the opinion was expressed that open through joints at intervals should be left in the main sections in each season's work on the dam and that these should be closed in the cold seasons following that in which the work is built, a space of time of not less than three months being left between building the work and closing the joint.

This ensures that at the time of closing (which is in effect a keying up of the horizontal arches comprising these sections) the masonry shall all be at a temperature decidedly below normal.

It is proposed that in each horizontal arch there shall be 4 through joints thus dividing each arch into 5 separate lengths of each about 400 feet in length. The joints left to be three feet wide and be radial.

The rubble facing in the upstream side should be built across the joint three feet thick but the downstream side should be left open.

In section I (the surplusing section) over the top of the opening, a rough brick arch should be turned covered with two feet of rubble to prevent the surplus water passing over this section of the dam falling into this space.

This top filling and arching will be removed the following season before filling up the joint.

In the sketch the open space is shown three feet wide.

The rubble hearting of the dam forming the sides of the opening will be left rough.

When closing the joint (some time in the month of January or February), the 3 feet opening will first be cleaned well out and the stones on the sides of the masonry, where these have been exposed to submergence (in section I), cleaned with a water jet or sand blast.

A rubble in surki wall 2′ 8″ thick to fill up the opening will then be built, leaving a space 2 inches all round between the new and old masonry.

This space will be run with Portland cement mortar every few feet of height of the new masonry making a tight joint between this and the old.

The facing of the downstream side will be built up to and jointed in with the facing on either side of it.

No provision is made in the estimate for the construction of these temperature joints. The extra cost will be little more than the cement involved and a large item for cement for miscellaneous work (2 per cent on the total rubble masonry) has been made in the estimate.

The construction of temperature joints is unusual and they have only, so far as I am aware, been made in the Olive bridge dam (now under construction) in America. The joints in that dam are through joints to be cemented up with some plastic material. According to the description given motion of the joint was provided for, a plastic material permitting this and still remaining water-tight. Not being acquainted with any material which is sufficiently elastic for such a purpose, the proposal here made is to close the joints permanently as soon as the material composing the dam is at a temperature suitable for "keying up".

The size of the works proposed are so great that some such precaution seems called for.

109. *Face finish to the dam.*—The nature of the finish to the upstream and down-stream faces of the dam is not specified and merely a rate per square allowed for in the estimate (Rs. 15 upstream face and Rs. 10 downstream face).

For the upstream face, it is important to get water-tight jointing.

Deep pointing in Portland cement put in before the masonry has long been laid and caulked into the joints is suggested but the matter is left for future decision.

The upstream face finish must be carried up with the work and on no account be left to be done at some future period.

On the downstream side it is considered that flush pointing with Portland cement is suitable. The cement should be flushed thin over the face of the stones to make these smooth and thus facilitate harmless passage of surplus water over the surface. It may be desirable to whitewash the downstream face of the work in later stage of construction so as to diminish temperature change due to the effect of the direct rays of the sun on this face.

This would no doubt detract from the appearance of the work but this is a secondary consideration.

110. *Types of sluices.*—The design of the supply sluices are of two types as regards distribution of masonry. The deep supply sluices are (as in the case of the sluices in the Assouandam) of the nature of culverts through the solid dam. In front of the culverts and upstream of the general face of the dam is built the masonry containing the wells over and through which the sluice gearing is installed. On the downstream side, the section of the dam is increased to distribute the extra pressures on the piers caused by the piercing the dam.

The central and right supply sluices are designed as a series of isolated piers, in grooves in which the sluice shutters run.

Over the top of the vents masonry panelling is provided built in Portland cement mortar of suitable thickness to safely span the space between the piers and resist the water pressure, and behind this the sluice shutters run. Over the piers at a high level, arches are sprung to carry the roadway and sluice gearing. The main surplus sluices are of a similar type but in this case steel girders carry the lifting wynches and roadway and no panelling over the opening above the shutters is called for.

111. *Type of sluice gates and gearing for supply sluices.*—The sluice shutters provided for in the dam are all steel shutters moving on free rollers. In right and central sluices the weight of the shutter is counter-balanced and the sluice shutters are to be hung on wire ropes or chains. For the construction sluices and deep supply sluices in which the lift to fully open the sluice is only 12½ feet, the raising and lowering mechanism was specified to be a central screw shaft. This is the system adopted in the Darna dam (Bombay) the shutters for which are the same size and were made by Messrs. Ransomes and Rapier.

Detailed drawings of sluice shutters and gear are not worked out, this being premature, but Messrs. Ransomes and Rapier have kindly furnished skeleton drawings and designs and have given quotations which find place in the estimate (letters No. 7278, dated 26th June 1910, and 1st July 1910). This firm has expressed a preference for the type of gear in which the shutters are suspended by wire ropes, as compared with the screw gear, giving as one reason for the preference that with the screw gear the shutter cannot conveniently be raised high into its well for painting, and that when kept only just raised clear of the opening it is very difficult to get it quite dry and thus the paint does not adhere properly. This is, especially for the deep supply sluices, an important point and the question of gear will need reconsideration before shutters are ordered.

The shutters of the construction sluices are interchangeable with those of the deep supply sluices. As it is required to use both these sluices simultaneously, it will not be practicable, as originally proposed, to use the former in the latter sluices, but these shutters after withdrawal will become spare shutters and allow six shutters to be always ready to replace those withdrawn for painting and repairs.

This undoubtedly is an additional argument in favour of the rope suspension of shutters recommended by Messrs. Ransomes and Rapier, as against the screw gear, as withdrawal is a much more easy operation in the former case.

The shutters as at present proposed for both construction and deep supply sluices are designed to be safe under a head of 110 feet over the cill and to work with a head of 70 feet over the cill.

The front (upstream) wall over and upstream of sluice gates are to be built of rubble in Portland cement mortar as was done for the Assouan dam. For the deep supply sluices cutstone arches in cement are provided.

A roller curtain for closing one of the orifices in front of the deep supply sluices and another roller curtain for the central supply sluices have been provided for, with the necessary joists for hanging the curtains from, as shown in Messrs. Ransomes and Rapier's skeleton design.

These enable repairs to be carried out and the shutter withdrawn when the water-level is above the orifice.

A crane for operating the curtains is also provided for. One crane can operate both deep and central sluice curtains.

Rails for the crane have not been specially provided for as probably there will be a large stock of surplus rails at site.

Special arrangements will have to be made for getting the crane round the angle between the deep and central supply sluices but no difficulty is anticipated in providing for this.

112. *Sluice gates and gear, main surplus sluices.*—The shutters and gear for the main surplus sluices are proposed to be of the type of steel shutter on Stoney Rollers, used as surplus works for the Periyar Lake, and skeleton designs have been obtained with quotations from Messrs. Ransomes and Rapier and the quotations of this firm are embodied in the estimate. Over the surplus sluices a cart road is provided for and the steel work for this is included in the tender cost of the sluice shutters.

113. *Closure of construction sluices.*—It is proposed that the construction sluices shall be permanently closed when the dam (section I) reaches a height about + 710.

To close one of the sluices the shutter will be lowered and a 12-inch drain pipe laid along the floor through the culvert. This will take the leakage through the sluice gate joints.

The pipe will be cased in cement mortar and the whole culvert built in surki rubble masonry and jointed up to the sides and face of the culvert with Portland cement small stone concrete well rammed.

The upstream end of the pipe will be then plugged and the pipe can be filled up solid with cement grout.

The sluice shutter and gear can then be removed and will serve as spares for the deep supply sluices.

114. *Constructional sections of the dam.*—For the purpose of reference and sub-division of labour and arrangements of surplus during construction, the length of the main dam is divided into five sections as below :—

Deep section (sections I and II).	Section I.—Length of 900 feet over the river bed which will be used for surplusing during the "flow season." Section II.—Remaining parts of the deep section.
Middle section ..	Section III.
Left section	Section IV.—The part of the dam and central supply sluices on the rocky hillock (Campbell hill). Section V.—The section of the dam between Campbell hill and Stoney's ridge. Section VI.—The part of the dam and right supply sluices standing on Stoney's ridge.

115. *Dry season discharge of the Cauvery.*—The river supply gets low in November or December. From the date in December in which the discharge falls below 6,000 cusecs, in the 28 years for which we have readings at Bhavani bridge (viz., from 1882), there are only two years in which, after a fall and continuance for six days below 6,000 cusecs, there is a subsequent rise to over that after 1st December, viz.—

1886.—River falls 2nd December but rises 9th December and does not again fall till 10th January.

1903.—River falls 20th November. Rises on 6th December and does not again fall till 28th December.

Generally work can be commenced when flow in river after the 15th November, has fallen to 6,000 cusecs (gauge reading 2 feet or below on Bhavani bridge gauge).

The normal date of commencing working season is taken as 1st December.

From January the river can be counted on as secure from freshes exceeding 6,000 cusecs up to 9th May.

On a fair computation, one can safely count on a dry season of 5½ months meaning a season immune from floods in the Cauvery of over 6,000 cusecs. The normal "dry season" may be taken as being 1st December to 15th May in the early stages of the work. During this period arrangements must be made to pass freshets up to 6,000 cusecs, but the usual flow will not be likely to exceed 1,500 cusecs and may go as low as 200 cusecs which can be taken as the probable minimum flow.

116. *Disposal of dry season discharge when work is below river-bed level.*—The arrangements proposed for disposal of dry season flow of Cauvery while excavation of foundations and work below river-bed level is going on are as follows :—

The deep rift, or depression, in the river bed above and below the dam site will be closed by solid masonry walls AA founded on rock and rising to + 662 (about).

Sockets, 4 feet apart, should be built into the top of the wall for fixing standards each dry season, to facilitate closing the waterway over these walls up to a level of + 628.

Masonry piers, 3 feet wide 10 feet long, rising to + 630, to be built across the river at intervals in the clear of 15 feet with a groove on each side of each pier.

These piers will be built about 150 feet upstream of the dam site.

The spaces between piers will be blocked as required with rolled steel beams and needle made of corrugated iron sheets. Thus water may be diverted through any openings desired.

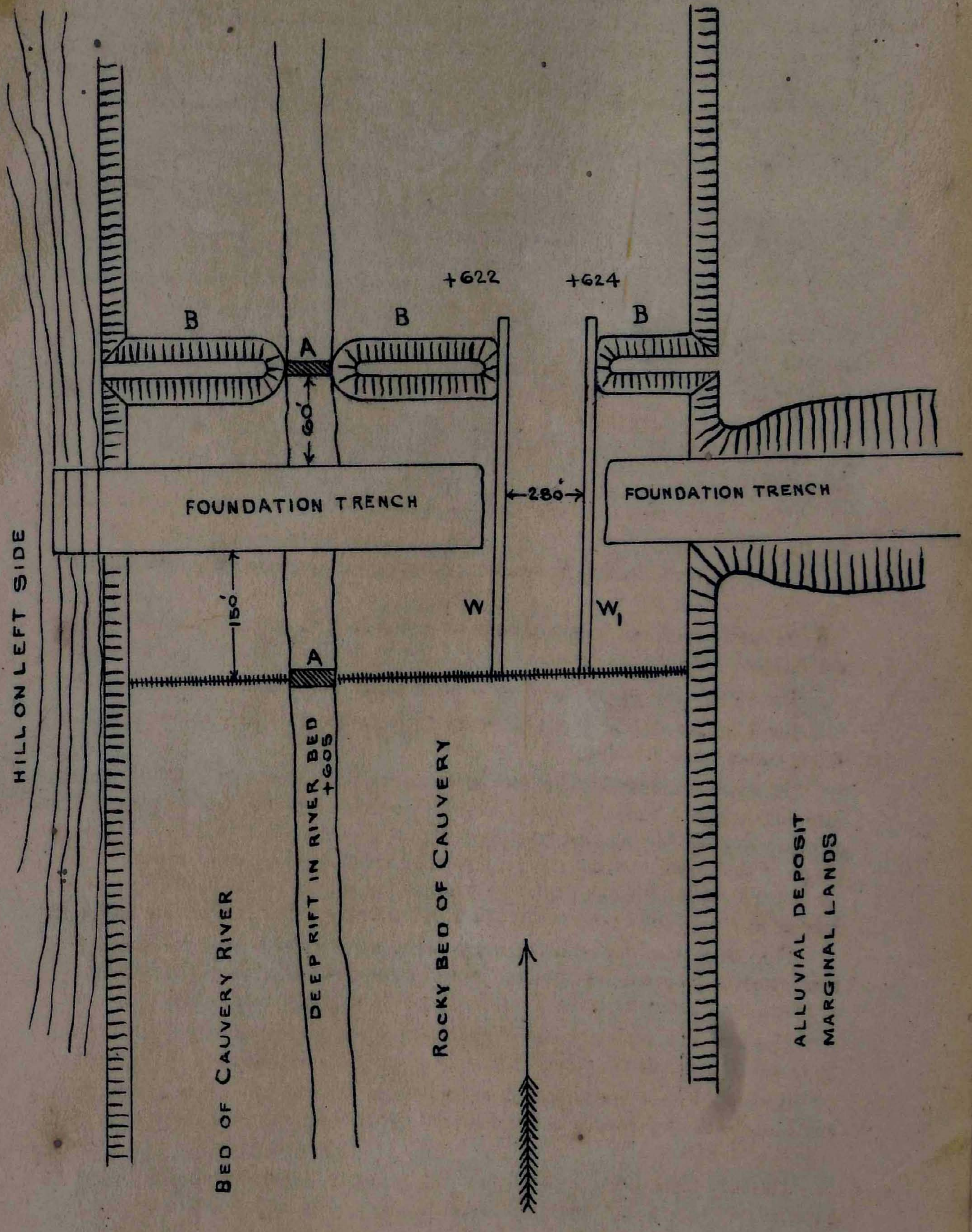
Two longitudinal walls, 450 feet long, W and W, with top at + 628, be built on the rock bed of the river as in the sketch plan.

The dry weather flow is normally about 1,000 cusecs but may between January and April run up to as much as 6,000 cusecs, and it is proposed to carry this between the walls W_1 and W, about 280 feet apart.

Water running through this at 5 f. s. will take 6,000 cusecs with a depth of 4½ feet.

The ordinary dry weather flow of this will be about 1½ to 2 feet deep or less.

The banks will be thrown up at BBB to keep out the tail water from the foundation space. Pumps will keep clear of water the foundation trenches and enclosed spaces.



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NOTE.—Reproduced from the original received from the Chief Engineer, for Irrigation Madras.

Vandyke., Survey Office, M
1925.

When the foundation trench is down to hard bottom on both sides of the two walls W and W_1, it will be necessary to turn the water into another channel to excavate the 300 feet between the walls left unexcavated. For instance it is practicable to turn the water to the right of the wall W_1, meanwhile taking out the trench close up to the foundations of this wall, leaving a short unexcavated length in the trench on which unexcavated rock W_1 stands.

This unexcavated piece would be about 15 feet wide and may be left standing if necessary till the third dry season.

The first year that building of masonry commences, a suitable length of foundation should be pushed on in advance of the rest of the work up to river-bed level and the flow water carried over this between walls built on it, while the rest of the foundation in the river bed is being put in.

117. *Disposal of "dry season" discharge when work is above river-bed level.*—This discharge will be led between guide walls through a gap about 280 feet wide left in the dam until the walls on either side of this opening are, say, 5 feet above the river bed.

The water will then be diverted through construction sluice vents and the gap closed. When the section I of the dam is over 5 feet above the river bed, a notch, 300 feet long and 4 feet deep, will be left in its left end to supplement in abnormal freshes the power of the construction sluices.

118. *Discharge power of construction sluices and notch in section I.*—The discharging capacity of the construction sluice is—

Water level above sluices.		Discharge cusecs.	Water level above sluices.			Discharge cusecs.
624	Cill of sluice	*Nil*	644	18	4 feet deep	7,174
628	4 feet deep	892	648	22	,,	8,194
632	8 ,,	2,523	652	26	,,	9,268
636	12 ,,	4,637	656	30	,,	10,160
640	14 ,,	5,668				

The normal dry season freshets (up to 6,000 cusecs) can be taken through the construction sluices with a depth of 15 feet.

The ordinary dry season flow is 300 to 800 cusecs and will be passed with a depth under 4 feet over the sluice cills.

The abnormal freshet runs up in May to and over 10,000 cusecs (3 years in 28 years).

The works must be arranged to pass over a section of the dam a discharge up to, say, 8,000 cusecs in addition to what is passed through the sluices.

It is proposed that the width of the notch left for this is 300 feet.

The depth of discharge will be—

	Cusecs.		Cusecs.
1 foot deep	930	3 feet deep	4,830
2 feet deep	2,614	4 ,, ...	7,440

A notch, 300 feet wide and 4 feet deep below the rest of the work, should be left in section I to pass abnormal freshets and to supplement the construction sluices until the level of this section of the dam is raised to about 672 in the sixth year of construction.

Such a notch will also be useful in a year of low river in allowing preliminary work for this season's building operations on the section I of the dam to be undertaken in October or November when the full flow of the river can be taken all through the 300 feet notch combined with the construction sluices.

119. *Disposal of floods of Cauvery during construction of dam.*—Floods of any magnitude occur only in "the flow season" June to November when the operations for construction of the section of the dam over the existing river-bed (section I) are in abeyance.

A statement of the dates and discharge of the highest and second highest floods of each year for the past 28 years at Bhavani bridge is printed at the end of this section.

These discharges are taken from the curve of discharges which may be considered as correct up to gauge readings 11 feet, but above this are probably rather lower than actuals.

They suffice however for dealing with the discharges to be provided for during construction.

In the *flow season* there will be no obstruction to normal flow of the river until the dam rises above the river-bed level.

After this stage it is proposed to carry the floods over the top of that portion of the dam which spans the existing river bed.

This portion (section I), a length of 900 feet, will be kept 18 to 20 feet below all other parts of the dam and thus forms a surplus weir 900 feet in length.

It is further arranged that for purposes of discharge of May freshes which occur in some years that a length of 300 feet of the above section shall be kept a further 4 feet below the other 600 feet, until the dam No. I section rises to crest level + 672, that is, as computed until the sixth year.

Thus the surplus weir will consist of a weir 300 feet long and a second weir 6C0 feet long, the crest of the latter being 4 feet higher than the former.

The discharge for varying levels measured over the *lower level* will be as under :—

Feet.		Feet.	
2	2,610	12	80,730
4	7,440	14	107,260
6	18,870	16	137,230
8	35,910	18	168,164
10	36,670	20	202,149

The normal *yearly flood* discharge of Cauvery may be taken to be 11 to 13 feet on the Bhavani bridge gauge, viz., 80,000 to 100,000 cusecs, while an abnormal flood will discharge up to about 170,000—a possible but improbable flood may be above 200,000 cusecs.

The ordinary normal good flow of Cauvery in July, August, September is about 40,000 to 50,000 cusecs.

The design of the surplusing length of dam provides for a curved connecting face, between the river-bed rock and the downstream face of the dam, built of wedged stone in cement, and this will form an efficient guide for the water which will flow with great velocity over the downstream face of the dam. (See diagram of profile next page).

This face should be kept as smooth as possible and no projecting stones should be allowed on it, while it must be flush pointed which cement as the masonry proceeds. A curved coping of rubble in surki mortar plastered with cement, as shown shaded in the sketch, should be constructed in April on the lower 300 feet, and in May on the higher 600 feet of the No. I section, to guide the water over the crest and make it adhere to the face of the dam throughout its descent.

The arrangements, if found inadequate as a protection to the rive-bed toe of the dam or downstream face, must be supplemented by a cushion dam below; it is believed that this will prove unnecessary.

The Austin dam, Colorado, is a case of surplusing similar to the proposals. The dam failed, and failed by scour just under the downstream toe, but a reference to the history of the work and the nature of the foundation rock, and arrangement of surplusing the tail water from the turbines, will show that the dam failed rather from neglect of reasonable precautions, and after many warning indications, than through the method of surplus adopted.

It is considered that the history of this dam is a justification for the proposals made for surplus during construction.

It is proposed the deep supply sluices should be freely used as surplus sluices during construction and should be allowed to pass water up to a maximum of 30,000 cusecs. The sluices can pass discharges as below :—

Water in reservoir.	Approximate discharge capacity.
+ 690	9,700
+ 700	20,000
+ 724	30,000

The "run off" channel is only designed to carry this maximum quantity.

These sluices will be available to pass surplus (according to the programme of construction) from the seventh year.

In the eighth year No. V section of the dam used to supplement other surplus works at a level + 710. The highest level of the main dam (section I) over which it is proposed to pass surplus water is + 713, ninety feet above the general rock level in the river bed.

During one year (the ninth) it is proposed to pass floods over both sections IV and V at a level + 730. In the dry season of this year, No. I section is to be raised from 713 to 745 and from this time no surplus will be passed over it.

From the tenth year surplus water will be diverted through the main surplus sluices on the saddle.

120. *When supply first given for new irrigation.*—Irrigation supply for the new area will be given first from the sixth year, the construction sluices being utilized to enable the gross capacity to be made fully effective.

The construction sluices will finally be built up in the ninth dry season.

121. *Considerations for fixing the gross capacity of the reservoir.*—In fixing the capacity of the reservoir, the chief considerations are—

(1) The requirements of the irrigated area and what capacity would best meet the requirements, and what is the capacity which would fully do so.

(2) To what extent increase or diminution of capacity from any specified figure would affect cultivation and cost of the work.

(3) The gradual diminution of effective capacity by deposition of solids in the reservoir bed.

(4) Considerations of height of full reservoir which best suits the site, especially as regards making the best use of the surplusing saddle.

As regards the deposition of solids the probable yearly deposition appears to be between 100 and 150 millions cubic feet, but to be quite safe for purposes of computation of the worst possible 200 millions is taken.

The study of the working tables year by year is required to enable an opinion to be formed on questions (1) and (2) above.

From the tables it appears that efficiency would suffer if the effective capacity of the reservoir were less than 70,000 millions cubic feet.

Under the worst condition of silt deposition, with a gross capacity of 90,000 millions cubic feet, an effective capacity (70,000 millions) will be available at the end of 100 years and the period probably would be more near 150 years.

The gross capacity of the reservoir proposed is 90,000 millions cubic feet and of this 80,000 millions is fully effective on the first construction. This 80,000 millions will be the probable fully effective capacity for about 75 years from construction and then the capacity will be reduced gradually year by year till at the end of 150 years it will be 70,000 millions.

From the working tables it can be seen that such a reduced effective capacity would have prejudicially affected supply in two years in the last twenty, viz., 1899-1900 and 1904-1905. The loss of the extra 10,000 millions cubic feet storage would not have been disastrous in these years, but it would have been appreciable.

The further loss of 10,000 millions cubic feet would have affected supplies in these two years to a much more appreciable extent, and further in 1908-1909 serious failure in supply to second crop would have been experienced.

The saving in reduction of gross reservoir capacity below 90,000 millions cubic feet proposed has been estimated at Rs. 1 lakh per 100 millions cubic feet capacity.

The level of full reservoir due to 90,000 millions gross capacity is very suitable for fully utilizing the surplusing saddle.

After carefully considering the above, the capacity proposed, viz., 90,000 millions gross capacity, has been judged to be the most suitable.

A statement of the dates and discharge of the highest and second highest yearly discharge computed from recorded daily gauge readings at Bhavani bridge for the past 28 years is as follows :—

Year.	Date.	Gauge readings.	Rough equivalent cusecs from curve of discharges, Bhavani bridge gauge.	Remarks.
1882	23rd July	17·5	195,000	
	18th ,, ...	17·2	180,000	
1883	26th ,, ...	13·7	120,000	
	25th ,, ...	12·87	111,000	
1884	31st August	13·21	112,000	
	1st September	12·7	108,000	
1885	19th August	11·92	95,000	
	16th ,, ...	11·87	95,000	
1886	19th July	11·0	82,500	
	18th ,, ...	10·33	73,000	
1887	16th ,, ...	12·84	109,000	
	17th ,, ...	12·46	104,000	
1888	11th ,, ...	11·75	94,000	
	12th ,, ...	10·92	81,000	
1889	16th October	11·25	86,000	
	10th ,, ...	11·17	85,000	
1890	24th July	10·08	71,000	
	27th ,, ...	10·0	69,500	
1891	25th and 26th July	12·0	98,000	
	30th July	11·21	85,000	
1892	23rd ,, ...	15·75	161,000	
	24th ,, ...	14·54	138,000	
1893	12th October	11·84	94,000	
	13th ,, ...	10·17	72,000	
1894	22nd July	12·21	99,500	
	23rd ,, ...	12·0	98,000	
1895	3rd August	11·04	82,500	
	11th ,, ...	10·96	82,500	
1896	30th July	18·25	207,000	Maximum record of 28 years.
	1st August	17·87	201,000	
1897	13th ,, ...	15·84	161,000	
	12th ,, ...	15·63	160,000	
1898	30th July	11·6	91,000	
	14th November	11·3	86,000	
1899	20th June	9·55	64,000	
	19th ,, ...	9·25	60,000	
1900	14th August..	17·45	194,000	
	15th ,, ...	16·82	179,000	
1901	12th July	12·05	98,000	
	13th ,, ...	11·7	92,500	
1902	19th ,, ...	16·25	169,000	
	18th ,, ...	16·0	165,000	
1903	31st July and 1st August	16·0	165,000	
	14th November	15·55	156,000	
1904	6th July	14·35	133,000	
	7th ,, ...	13·95	129,000	
1905	24th and 25th July	11·75	94,000	
	26th July	10·75	80,000	
1906	25th ,, ...	13·0	112,000	
	24th ,, ...	12·75	109,500	
1907	10th August	14·9	146,000	
	11th ,, ...	14·2	132,000	
1908	7th ,, ...	11·5	89,500	On 12th June 1909 11 feet flood. It is quite unprecedented to get a large flood so early.
	29th July	11·25	86,000	
1909	20th ,, ...	11·9	95,000	
	19th ,, ...	11·5	89,500	

SECTION IV.

Building Materials and Rates.

122. *Stone.*—The stone proposed to be employed for rubble or concrete is 'charnockite' chiefly obtained from the low foot hills on the right side of the Cauvery. Three inches cubes of this stone have been weighed, and crushed in a testing machine; also specimens of stone have been crushed in Blake and Marsden's stone crusher. The stone crushed into well-shaped prismoidal pieces.

The weight averages per cubic foot, 165·3 lb

Crushing strength per square inch, 7·95 tons.

The Geologist's report on this stone is as follows, speaking of the charnockite:—"A medium grained, compact, and very tough rock, and is eminently suited for a building stone in which strength is required."

The gneisses from the hills bordering the left side of the river were also tested for crushing for concrete, for weight, and for crushing strength. The results were equally favourable while the crushing strength as noted below is even higher: —

Weight per cubic foot, 169·4 lb.

Crushing weight per square inch, 10·26 tons.

Gneiss will be used for the dressed stone for lining vents, for archwork, copings, etc., as it is more easily worked than charnockite. For the rubble and concrete the latter is on the whole preferable, not only because more conveniently placed for quarrying but also because all this description of stone found is 'fresh' and in good condition, whereas surface gneiss is often weathered and inferior in quality.

If convenient, however, there is no objection to employment of 'fresh' gneiss for concrete or rubble work.

123. *Sand.*—Sand in the river is good, clear granitic sand, but it occurs in scattered patches and is not continuous.

The largest bed is reported to be at the outfall of the Thoppiar river and about 2,500 feet in length by 250 feet wide, while at every sharp curve of the river sand deposits are found.

The Thoppiar river bed is sandy throughout.

A regular 'sand survey' has not been made and should be undertaken at once if the works are sanctioned. It is proposed to collect sand by dredging with a grab worked from a barge and carry it in barges to site of works, or alternatively to dig it and place it on the margins when the river-bed is dry and boat it to site when water is available.

The lead for sand will vary from a few feet up to six miles (the outfall of the Thoppiar is 6 miles above the dam).

A rate of Rs. 2 per 100 cubic feet has been allowed to cover all costs of excavation and conveyance. The quantity of sand required will be about 8,000,000 to 10,000,000 cubic feet.

124. *Lime.*—The quality of lime and the distribution of the deposits are of very great importance.

The limestone is all a deposit of 'kunkur.' There is no crystalline limestone in the vicinity of the site.

About 6 million cubic feet of kunkur limestone is required for the works.

Lime is obtainable in the form of deposits of kunkur on both sides of the river.

On the left side (Salem district).—(*a*) There are lime fields well known and worked at Nangavalli village about six miles from the surplusing saddle site (field Nos. 229, 226, 235, 238, 239, 100, 102, 104). The area of the deposits here is not less than 30 acres of an average thickness of 3 feet.

Samples of this lime have been tested with very satisfactory results (*vide* sheet of lime tests following).

(*b*) There are lime deposits here and there in scattered patches in the vicinity of the Thottilpatti vari less than three miles from the dam site.

The quantity here is considered too small and scattered to depend on for the main supply.

This lime has been tested and results are quite satisfactory. It would probably be used in constructing the main surplus sluices.

On the right of the river (Coimbatore district).—The lime deposits here are found in the waterspread area north and south of the cart-track from Sampalli to Kolathur, while near and beyond Kolathur village-site there are deposits of lime at level about + 800 (above the full reservoir level).

Two statements following show the results of the search for lime made, from examination of numerous trial-pits, etc., and give the survey number of the fields (which are marked on the waterspread map) where lime has been located.

The most promising deposits are noted on the No. 1 statement, while No. 2 gives details of deposits which appear of less promise but may repay further investigation. The lime from plot No. 1-K is that appearing in the test sheet as 'Kolathur lime'.

It is proposed that the bulk of the lime shall be got from the Coimbatore side of the river.

That in the waterspread would of course first be worked out being nearer to the works and liable to eventual submergence.

Later on the fields beyond Kolathur can be worked if found necessary, but this is believed to be unlikely.

The detail of these is given in Statement No. 3 which is recorded with the file regarding tests of materials and is not included in this report.

The lead for lime allowed is nine miles (the distance to Kolathur plot 1-A), but it is likely to be less for the greater part of the supply.

The lime samples from Nangavalli and Kolathur tested were burned in a small kiln and gave an outturn of 50 per cent bulk more slaked lime than the volume of the raw kunkur stone.

Some kunkur taken from deposits along the right margin of the river close to the dam site which were burned as a test gave so poor an outturn of lime that this stone is considered useless.

Latter information of samples taken from plots 10 and 11 have given unsatisfactory results; on the other hand promising results have been obtained of burning a sample of lime from plot 10-A.

Further detailed investigation regarding deposits of kunkur is called for, but there is no doubt of the existence within ten miles of the work-site of ample supplies of lime of high class quality.

(1)

CAUVERY RESERVOIR PROJECT.

Statement showing survey numbers, etc., of kunkur fields which promise supply of good kunkur on right side of Cauvery near Metur site.

Level G.T.S. datum	Plot number.	Name of village.	Field survey numbers.	Extent. Acres.	Extent. Cents.	Depth at which Kunkur is found below ground levels.	Thickness of kunkur bed.	Remarks.
		Mulakad Fields.						
Between + 770 and 780.	5	Mulakad (Bhavani taluk).	S. No. 70.	4	0	1′	2′	These 10 acres equivalent to 62 acres of 1 foot thick.
Between + 760 and 770.	6	Do.	Portions of S. Nos. 78, 80, 72 and 74.	6	0	1′ 6″	3′ to 15′	
				10	0			
		Perumalkavundanoor Fields.						
Between 750 and 760.	8	Sampalli village ..	S. No. 6′6.	4	0	1′ 6″	3 to 10′	Equivalent to 148 acres 1 foot thick.
Between 750 and 760.	9	Do. ..	S. No. 657.	3	0	1′ 6″	2′	
Survey Nos. 665 and 666 are between + 730 and 740, Survey Nos. 610 and 611 are between + 740 and 750.	10	Do. ..	S. Nos. 665, 666, 610 and 611.	10	0	1′ 6″	3′	
..	10 A	Do ..	S. Nos. 334, 335 and 336.	16	0	2′	3′	
Survey Nos. 672 and 673 are between + 720 and 730, Survey No. 677 is between + 710 and 720.	11	Do. ..	S. Nos. 672 673 and 677.	10	0	1′ 6″	3′	
Above + 790 ..	12	Do. ..	S. No. 618 and portion of S. Nos. 617 and 616.	6	0	1′ 6″	3′	
				49	0			
Above + 800 ..	1 K	Kolathur village .	Portions of S. Nos. 133, 132 and 148.	6	0	1′ 0″	3′	Equivalent to 36 acres 1 foot thick.

Rough estimate of total quantity of kunkur available in above plots = 246×43,560×1 = 10,715,760 feet.

The tested lime called 'Kolathur lime' was taken from this plot 1-K. The field numbers are marked on the waterspread map of the reservoir.

The full level of water + 788.

(2)

CAUVERY RESERVOIR PROJECT.

Statement showing survey numbers, etc., of kunkur fields investigated but the quality of kunkur believed to be inferior.

Item number.	Name of village.	Survey numbers.	Extent. Acres.	Extent. Cents.	Depth at which kunkur is found.	Thickness of kunkur bed.	Remarks.
	Mulakad fields.						
1. Above + 800 ..	Sampalli (unsurveyed portion).	..	2	0	1′ 0″	1′	Quality poor and slaking poor.
2. Do. ..	Do.	..	1	0	1′ 6″	1½′	Quality poor, does not slake well.
3. Do.	Do.	..	3	0	1′ 0″	1′	Same as No. 1.
4. Between 750 and 760.	Do.	S. Nos 55 and 56.	8	0	1′ 0″	2′	Kunkur hard and does not burn well.
7. Between 735 and 750.	Do.	S. Nos. 781 and 782.	6	0	1′—6″	1½′	Kunkur not good and does not burn well.

Items 1 to 3 not marked in plan. They are unsurveyed and above level + 800.

(3)

Cauvery Reservoir Project, Metur Site.

Kolathur Kunkur Lime.

Table of tensile breaking strengths of mortar per square inch.

(The figures in thick type show the number of briquettes of which the average breaking stress was taken.)

Set damp in air.

Time after making briquettes.	1 : 1 : 1	1 : 2 : 1½	1 : ½ : 2	1 : 1 : 2	1 : ¾ : 2	1 : ¾ : 1½	1 : 0 : 2
	LB.	LB.	LB.	LB.	LB.	LB.	LB.
Five weeks ..	137·7 / **5**	93·3 / **7**	93·5 / **7**	119 / **7**	108 / **7**	110·7 / **7**	64·6 / **6**
Eight weeks ..	142·5 / **7**	94·3 / **7**	110·1 / **7**	170·1 / **5**	160·7 / **7**	117·5 / **7**	68·9 / **7**
Twelve weeks..	156·9 / **4**	113·1 / **4**	126·6 / **6**	171·7 / **6**	156·2 / **6**	173·7 / **6**	113 / **5**

Set in water.

Time after making briquettes.	1 : 1 : 1	1 : ½ : 1½	1 : ½ : 2	1 : 1 : 2	1 : ¾ : 2	1 : ¾ : 1½	1 : 0 : 2
	LB.	LB.	LB.	LB.	LB.	LB.	LB.
Five weeks ..	166·1 / **9**	103·2 / **7**	92·8 / **9**	137·6 / **9**	132·2 / **9**	131·1 / **9**	58·2 / **6**
Eight weeks ..	158 / **8**	109 / **5**	101·1 / **8**	168·9 / **9**	158·4 / **8**	160 / **8**	60·2 / **6**
Twelve weeks..	179·5 / **4**	77·5 / **4**	112·1 / **6**	175·7 / **7**	184·3 / **7**	208·9 / **7**	61·35 / **7**

Set dry in air.

Time after making briquettes.	1 : 1 : 1	1 : ½ : 1½	1 : ½ : 2	1 : 1 : 2	1 : ¾ : 2	1 : ¾ : 1½	1 : 0 : 2
	LB.	LB.	LB.	LB.	LB.	LB.	LB.
Five weeks ..	65·8 / **2**	49 / **2**	45 / **2**	51·7 / **2**	43·7 / **2**	46·7 / **2**	37·5 / **2**
Eight weeks ..	65 / **2**	65 / **2**	62·2 / **2**	57·5 / **2**	51·25 / **2**	71·25 / **2**	45 / **2**
Twelve weeks..	62·5 / **2**	65 / **1**	55 / **2**	72·5 / **2**	75 / **2**	79 / **2**	70 / **2**

Note.—Kolathur lime and Grand Aniout surki mixed as shown gave under-noted result.

Time after making briquettes.	Set damp in air 1 : 1 : 2	Set in water 1 : 1 : 2	Set dry in air 1 : 1 : 2	All other columns
Five weeks ..	140 / **6**	120·7 / 7	55·7 / 2	..
Eight weeks ..	183·6 / **7**	173·6 / 7	46·2 / 2	..
Twelve weeks..	194·6 / **7**	245·6 / 7	66·7 / 2	..

Note.—Earth for surki dug on west side of road opposite mile $\frac{26}{8}$ Sampalli road close by where tents were pitched for standing camp.

(4)

CAUVERY RESERVOIR PROJECT, METUR SITE.

Nangavalli Kunkur Lime.

TABLE of tensile breaking strengths of mortar per square inch.

(The figures in thick type show the number of briquettes of which the average breaking stress was taken.)

Time after making briquettes.	Set damp in air.							Set in water.							Set dry in air.						
	1:1:1	1:½:1½	1:½:2	1:1:2	1:¾:2	1:¾:1½	1:0:2	1:1:1	1:½:1½	1:½:2	1:1:2	1:¾:2	1:¾:1½	1:0:2	1:1:1	1:½:1½	1:½:2	1:1:2	1:¾:2	1:¾:1½	1:0:2
	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.
Five weeks ..	157·1 / **7**	106·2 / **7**	112·2 / **7**	121·8 / **7**	122·1 / **7**	119·3 / **7**	65·3 / **6**	151·1 / **9**	107·4 / **9**	90 / **9**	112·8 / **9**	101·1 / **8**	92·1 / **8**	46·3 / **7**	40 / **2**	27·5 / **2**	38·7 / **2**	35 / **2**	52·5 / **2**	45 / **2**	33·3 / **2**
Eight weeks ..	181·1 / **7**	137·9 / **7**	160 / **7**	150·7 / **7**	138·9 / **7**	126·4 / **7**	81·7 / **7**	160 / **9**	131·1 / **9**	126·4 / **9**	137·2 / **9**	117·2 / **9**	110·4 / **7**	40·9 / **8**	41·25 / **2**	42·5 / **2**	62·5 / **2**	50 / **2**	68·75 / **2**	67·75 / **2**	46·2 / **2**
Twelve weeks ..	207·1 / **6**	135 / **6**	171 / **6**	156·3 / **6**	136·4 / **7**	147·5 / **6**	84·2 / **5**	155·4 / **6**	130 / **6**	156 / **6**	138·6 / **7**	108·6 / **7**	134·3 / **7**	52·5 / **9**	37·5 / **2**	36·6 / **3**	65 / **2**	38·7 / **2**	65 / **3**	63·7 / **2**	42·5 / **3**

(5)

CAUVERY RESERVOIR PROJECT, METUR SITE.

Thottilpatti Kunkur Lime.

TABLE of tensile breaking strengths of mortar per square inch.

(The figures in thick type show the number of briquettes of which the average breaking stress was taken.)

Time after making briquettes.	Set damp in air.							Set in water.							Set dry in air.						
	1:1:1	1:½:1½	1:½:2	1:1:2	1:¾:2	1:¾:1½	1:0:2	1:1:1	1:½:1½	1:½:2	1:1:2	1:¾:2	1:¾:1½	1:0:2	1:1:1	1:½:1½	1:½:2	1:1:2	1:¾:2	1:¾:1½	1:0:2
	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.	LB.
Five weeks ..	98·2 / **7**	..	..	39·3 / **7**	..	..	34·6 / **6**	90·8 / **9**	..	..	104 / **9**	..	..	41·8 / **7**	37·5 / **2**	..	..	37·5 / **2**	..	..	32·5 / **2**
Eight weeks ..	152·8 / **7**	..	..	156·1 / **7**	..	..	45·0 / **5**	118·3 / **9**	..	..	140·3 / **9**	..	..	58·2 / **7**	50·0 / **1**	..	..	57·5 / **2**	..	..	42·5 / **2**
Twelve weeks ..	196·7 / **6**	..	..	165·0 / **6**	..	..	43·8 / **4**	119·0 / **5**	..	..	..	..	..	53·6 / **7**	50·0 / **1**	..	..	65·0 / **3**	..	..	..

(6)

Cauvery Reservoir Project, Metur Site.

Grand Anicut Kunkur Lime.

Table of tensile breaking strengths of mortar per square inch.

(The figures in thick type show the number of briquettes of which the average breaking stress was taken).

Time after making briquettes.	Set damp in air.							Set in water.							Set dry in air.						
	1 : 1 : 1	1 : ½ : 1½	1 : ½ : 2	1 : 1 : 2	1 : ¾ : 2	1 : ¾ : 1½	1 : 0 : 2	1 : 1 : 1	1 : ½ : 1½	1 : ½ : 2	1 : 1 : 2	1 : ¾ : 2	1 : ¾ : 1½	1 : 0 : 2	1 : 1 : 1	1 : ½ : 1½	1 : ½ : 2	1 : 1 : 2	1 : ¾ : 2	1 : ¾ : 1½	1 : 0 : 2
	LB.	LB.	LB.	LB.	LB.	LB.	LB.								LB.	LB.	LB.	LB.	LB.	LB.	LB.
Five weeks ..	..	47·5 **6**	85·7 **7**	62·9 **6**	..	..	32 **3**	The briquettes fell to pieces when placed in water 24 hours after moulding.							..	..	..	15 **1**	..	..	22·5 **1**
Eight weeks ..	..	37·5 **4**	110 4 **7**	60 **7**	..	..	28·0 **5**								..	..	25 **1**	..	..	..	..
Twelve weeks ..	..	55 **3**	92 **5**	124 **4**	..	..	*125 **4**								.	..	..	..	..	..	..

* This result is so extraordinary that it must be regarded with some suspicion.

Remarks.—All other specimen broken before test.

Crushing tests of lime mortor made from limestone from Kolathur and Nangavalli.—From the larger size briquettes broken in tensile machine, having a breaking cross section of 2 square inches, 62 cubes were sawn of $1\frac{1}{2}$ inch side and these have been tested for crushing strength in the College of Engineering, Madras.

The briquettes were made between the 10th May and 24th May 1919 and were crushed on 8th October (approximate six months after making).

They were broken in tensile machine, some at five weeks, some at eight weeks, and some at twelve weeks from the time of making to the time of breaking. During this period one set was kept damp in air, another set was kept in water being immersed 24 hours after moulding. The results of tensile and crushing show no material difference in strength.

Another set were set under cover but not kept damp. These exhibit great deficiency both in crushing and tensile strength.

Details of tensile strengths have already been given in the preceding tables.

After breaking in tensile machine all the briquettes were kept dry but under a roof till time of crushing.

The crushing results, only two mixtures of mortar, are given, viz.:—

1 lime, 1 surki, 1 sand.
1 „ 1 „ 2 „

Further details of the crushing tests will be found in the Cauvery project file No. 219—"Tests of building materials" and letter No. 162 W., dated 11th October 1910, from the Principal, College of Engineering, Madras.

The results are as under—

Proportion—1 lime, 1 surki, 1 sand.

Set in the shade in air and kept damp.	Average of seven specimens crushed, 1,021 lb. per square inch. Average of same specimens in tensile strength, 140 per square inch.
Set in water ...	Average of ten specimens crushed, 1,082 lb. per square inch. Average of same specimens in tensile test, 138 per square inch.

Proportion—1 lime, 1 surki, 2 sand.

Set in the shade in air and kept damp.	Average of four specimens. Crushing strength, 1,033 lb. per square inch. Average of same specimens in tensile test, 175 lb. per square inch.
Setunder water ...	Average of eight specimens. Crushing strength, 1,092 lb. per square inch. Average of same specimens in tensile test, 179 lb.

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1 to 1 to 1 set dry in air.	Average two specimens crushing strength, 254 lb. per square inch. Tensile tests same specimens, 65 lb.
1 to 1 to 2 set dry in air.	Average three specimens crushing, 181 lb. per square inch. Average same specimens tensile, 69 lb. per square inch.

125. *Surki.*—The earth from which the surki was made for the lime tests was taken from the west of the road near Metur abreast milestone 26 M 2f.

There is plenty of similar earth between the dam site and Kullaverampatti and beyond this towards Metur.

Below the dam site suitable earth can be got but this ground is required for stores, workshops and camps and it will be best to get surki from above the dam site so long as water levels permit. This also gives facilities for delivery of fuel rafted or brought on boats down to river near the site where the earth is dug.

126. *Firewood.*—It is proposed to burn the lime and surki required for the masonry works with firewood cut from the submerged area and from the Government forests in the vicinity.

The matter of firewood supply has been the subject of correspondence with the Collectors or Forest Officers of Salem and Coimbatore and from the information given the following details are noted. It is to be understood that the estimates are rough and that detailed surveys and estimates for firewood supply should be made immediately on the sanction of the project.

The firewood which may be expected from the submerged area of Government forests is roughly estimated at—

	TONS.
In Salem district	17,000
In Coimbatore district	3,000
Trees in other area submerged ...	10,000
Total ...	30,000

Lead about 20 miles.

Firewood cut from reserved forests outside the water-spread area.

	TONS.
In South Salem, lead about 5 miles	18,000
In North Salem, lead 15 miles	98,000
In Coimbatore, lead 3 to 15 miles, say average 10 miles	47,000
Total ...	163,000

The cost cut and delivered in the "coupe" is roughly estimated at Rs. 5–4–0.

The District Forest Officer, Coimbatore, has kindly furnished me with his figures for the above cost which is noted below :—

	Per ton. RS	A.	P.
Felling	2	0	0
Line clearing	0	0	8
Shrinkage	0	1	7
Temporary buildings	0	1	3
Total ...	2	3	6
Royalty	1	8	0
Supervision	1	8	6
Grand Total ...	5	4	0

The cost of conveyance must be heavy and it has been deemed prudent to place the cost of firewood delivered at site of kiln at Rs. 10 per ton although there is reasonable prospect of realising it at a cheaper rate.

The total quantity of firewood required for the works for lime and surki burning is roughly estimated at 150,000 tons, while a further 20,000 tons will be required for cooking, steam launches, etc.

It will be necessary to post a superior officer of the Forest department with adequate staff to organise and supervise arrangements for cutting of firewood, construction of forest roads, and carriage to site and provision for this is made in the estimate. Failure in adequate fuel supplies delivered up to time connotes delay in execution of masonry works with corresponding great losses in interest, charges, etc.

It is considered that work would be best organised by placing an officer of the grade of Deputy Conservator under the orders of the Engineer-in-Chief in charge of the project, subject to professional control by the Conservator.

Among the "preliminary operations" which should be put in hand directly this project is sanctioned for execution, is the working out in detail of the scheme of firewood supply, the clearing and making forest roads, and the cutting and stacking in "the coupes" in the forests of large reserves of firewood, ready for conveyance as soon as the forest roads are completed.

It is probable conveyance from forests in the vicinity of the river upstream of the works will, most economically, be done in the local leather covered coracles, which float down with the stream and are carted back empty, five or six boats, of capacity ¼ ton each, being carried on a single cart. The District Forest Officer, Coimbatore, has suggested this method of transport of firewood cut near the river.

127. *Remarks on rates.*—The rates for the head works have been the subject of very careful consideration; and the rates provided for are very liberal, having in view the present prices of labour.

The tendency, however, is for the price of labour to rise, and it is possible that in the later years of construction a material rise in the cost of labour may necessitate the payment of higher rates.

To provide for such a contingency an item for "unforeseen works" of 10 per cent. on the cost of the works provided for (excluding preliminary expenses) has been entered in the estimate.

In every case very liberal allowances have been made for carriage of materials and sundry expenses and it is believed that the rates allowed are sufficient to attract labour and ensure rapid execution without any excess. The nature of the masonry proposed follows closely the type under execution on the Darna Dam (Bombay Presidency) now under construction, which was visited in April 1909.

These works have some advantage over those now proposed in the accessibility of the site and the cool and pleasant climate.

The labour rates allowed for the Cauvery Dam for building masonry of the same type as that at Darna Dam are very materially higher than those actually being paid to contractors on the latter work.

The proportion of mortar allowed for is the same as was stated to be used on the Darna Dam; there is reason to believe it is slightly more than is actually being used or required. The actual rate for rubble "hearting" on Darna Dam is understood to be under Rs. 19 against Rs. 24-4-0 allowed in this estimate.

Detailed data are given for the items of work which are of most importance and are susceptible of being so worked out, viz.—

Lime manufacture.	Rubble masonry.
Surki "	Concrete "
Mortar "	

Where cement is substituted for surki mortar in rubble or concrete an extra Rupees 23-12-0 has been added to the rate.

In addition, for 2 per cent. of the masonry an allowance for building in cement is added to cover any unforeseen difficulties with water, etc., in the foundations in which the use of cement may be desirable.

For the cutting down of the main surplusing saddle an all-round rate Rs. 35 is allowed.

Any hard rock to be removed here will be useful for masonry or pitching and will thus be worked at a cheaper rate than the softer rock covered by the above provision. The pits dug show that a great proportion of the work is soft rock.

The mortar provided for is the most expensive mixture tested, viz., 1 lime, 1 surki and 1 sand.

The tests show that 1 lime, 1 surki and 2 sand gives an excellent strong mortar and it may be desirable to substitute this for the richer mixture to which the tests show it to be almost equal in quality. To be on the safe side, however, the former is allowed for in the estimate. Reference to the tables showing tensile breaking loads per square inch of mortar reveals that the only set of briquettes made with the lime from the head works and surki from the Grand Anicut (where the mortar was ground and briquettes made) give materially higher strengths in every case to the mortar with Metur surki.

The latter gave excellent tests, but the former are still better.

Further experiment with local earths to get the best surki is recommended as well worth undertaking.

Cauvery Project.

Head Works at Metur.

	Rs.	A.	P.
Rates, Material—			
Charnockite or Gneiss Rough Stone quarried and stacked per 100 c. ft. (stack measurement allowing 12 per cent. interstices.)	4	8	0
Concrete stone of above	7	12	0
Firewood (at site of work per ton)...	10	0	0
Country bricks (for surki), 9″ × 4¼″ × 2″ per 1,000 ...	5	12	0
Lime slaked and screened and delivered at mortar mills per 100 c. ft.	19	10	0
Surki slaked and screened and delivered at mortar mills per 100 c. ft.	16	8	0
Rates for masonry and other work built complete and finished—			
Benching founds for dam per 100 sq. ft.	25	0	0
Excavation founds of dam—			
Hard rock including removal of material 1,000 c. ft.	80	0	0
Soft rock exclusive of leading away material from deep founds ...	25	0	0
Earth do. do. ...	10	0	0
Random rubble facing in surki mortar, 1 to 1 to 1; 100 c. ft. ...	26	4	0
Do. do. hearting do. ...	24	4	0
Concrete in surki mortar, 100 c. ft....	24	4	0
Rubble facing in cement, 100 c. ft.	50	0	0
Wedged stone in cement, 100 c. ft.	80	0	0
Cutstone archwork in cement per c. ft.	1	10	0
Do. square work per c. ft. in flooring side walls, etc.	1	4	0
Do. fine work in copings, etc.	1	6	0
Pointing with cement, 100 sq. ft.	4	0	0
Do. upstream face of dam, 100 sq. ft.	15	0	0
Do. downstream, 100 sq. ft.	10	0	0

Detailed Data.

Rate for Rubble (Small) Hearting.

In surki mortar.

Proportions by measure—

Lime	Surki	Sand.
1 :	1 :	1

	Rs.	A.	P.
Material—			
Stone quarried and stacked at Rs. 4-8-0 in stack (add $\frac{1}{9}$ for wastage)	5	0	0
Mortar, 1 to 1 to 1 (44 c. ft.) at Rs. 19-9-0	8	10	6
	13	10	6
Conveyance—			
Stone from quarry to workmen on dam, lead about 1½ miles ...	3	0	0
Conveyance of mortar	0	12	0
	3	12	0
Labour—			
2½ masons at Re. 1	2	8	0
2½ men at As. 6	0	15	0
2½ women at As. 4	0	10	0
	4	1	0

Note.—The rate paid for labour of building "hearting rubble," Darna Dam, is Rs. 3 including conveyance of stone from the foot of the dam up the slopes of the masons on the work (up to 50′ high).

	RS.	A.	P.
Sundries—			
Platforms for stone scaffolding, etc.	2	0	0
Contingencies	0	12	6
	2	12	6
Total ..	24	4	0

Rubble Facing.

This work is similar to the hearting but header stones at 4′ intervals horizontally and 1 foot vertically (each stone about $2\frac{1}{2}'$ long) are required to be built.

The stones must be shaped with the hammer to fit neatly on the face and must be truly bedded.

The extra labour involved is considerable and two extra masons are allowed per unit, viz.—

$4\frac{1}{2}$ masons per unit of face work.

This raises the rate for rubble facing to Rs. 26–4–0.

NOTE.—The rate paid, Darna Dam, for similar rubble facing *for labour* is Rs. 4–8–0 against Rs. 6–1–0 allowed in this estimate. On the Darna Dam this rate includes carrying the stone up slopes from the foot of the dam to the masons on the work up to 50′ lift and this is separately allowed for here.

Rate for Concrete in Surki Mortar.

	RS.	A.	P.
Quarrying, Rs. 3–12–0	3	12	0
Crushing or breaking stone	4	0	0
Conveyance to crushers	1	0	0
Mixing including conveyance to mixer and loading into it ...	1	8	0
Conveyance from mixers to dam and depositing and spreading as required.	1	8	0
Ramming and watering, 2 men at As. 6, ½ woman at As. 4 ...	0	14	0
Total ...	12	10	0
Mortar, 50 c. ft. at Rs. 19–9–0	9	12	6
Conveyance of mortar to mixer	0	4	0
Total ...	10	0	6
Sundries and contingencies	1	9	6
Total ...	1	9	6
Total per unit ...	24	4	0

Mortar Manufacture.

100 cubic feet lime	19	10	0
100 cubic feet surki	16	8	0
100 cubic feet sand	2	0	0
Total ...	38	2	0
Conveying material from sheds to mills and attendance on mills.	1	8	0
Grinding mortar	6	0	0
Total ...	7	8	0
Grand total ...	45	10	0

Outturn 233 cubic feet mortar (1 lime, 1 surki, 1 sand). Rupees 19–9–0 per 100 cubic feet of mortar.

Rate for Lime Manufacture.

Digging per 100 cubic feet	2	8	0
Conveyance	8	0	0
At site	10	8	0

	Rs.	A.	P.
Burring—			
100 feet kunkur	10	8	0
$1\frac{1}{2}$ tons firewood at Rs. 10 per ton	15	0	0
Loading and unloading, slaking and screening	3	8	0
Maintenance of kilns and sundries	0	8	0
Total ...	29	8	0

Outturn 150 cubic feet slaked and screened lime; rate Rs. 19-10-0 per 100 cubic feet.

Surki Manufacture.

	Rs.	A.	P.
2,000 country bricks, 9″ × $4\frac{1}{4}$″ × $2\frac{1}{8}$″ at Rs. 5-12-0	11	8	0
Breaking	0	8	0
Pulverising by machine including screening	3	8	0
Conveyance, handling, shedding and contingencies	1	0	0
Per 100 c. ft. ...	16	8	0

Or per c. ft. $2\frac{2}{3}$ annas (nearly).

Note—Per unit surki $\frac{1}{2}$ ton firewood required at Rs. 10 per ton.

SECTION V.

Programme of Construction.

Head Works—Cauvery Project.

128. *Quantity of masonry work and comparison with other works.*—The work to be built is of unprecedented magnitude having reference to the quantity of masonry to be built. Roughly this quantity may be stated at 38½ millions cubic feet of masonry.

Below for comparison is given the contents of masonry, and time of construction, of some dams in India and elsewhere:—

	Masonry. m. c. ft.	Time of construction.
Tansa dam	10·02	5 years.
Periyar	5·00	9 "
Darna	6·00	Under construction, Bombay.
Assouan	19·00	4 years.
New Croton	23·10	14 "
Olive Bridge	23·80	Under construction, New York water-supply.

129. *Mason's labour provided for in construction programme.*—The programme drawn up for the Cauvery dam construction allows ten years for the construction of the dam up to the time the full capacity of water can be impounded and utilised for irrigation, that is, full capacity is available from the tenth year.

It is based on the assumption that 580 masons are employed on building the dam for eight years continuously.

Of these, 480 masons are allowed (working 24 days monthly) for rubble masonry, while 100 masons are allowed for cutstone and other special works

130. *Preparatory works.*—The first two years will be occupied in "preparatory works" and excavation of foundations of the deep section of the main dam with the necessary diversion works in the river bed.

The excavation of foundations overshadows all other work in importance during these two years, as the completion of this must precede beginning masonry on this section of the dam. Most of this excavation can only be carried out in the dry season. The "preparatory works" will be carried out vigorously during these two years and consist of—

(*a*) quarrying and collection of stocks of stone, kunkur, firewood, sand;

(*b*) making roads and railed roads and laying rails;

(*c*) building quarters and lines, etc., for staff and workmen;

(*d*) constructing water-supply and sanitary arrangements;

(*e*) building offices, workshops, power-house, stores, hospitals, etc.;

(*f*) erection of power plant, workshop machinery, mortar making and crushing and hositing machinery, and erecting and arranging power transmission lines.

131. *Early quarry operations.*—It may be here mentioned that the earliest quarry operations should be undertaken on the line of the dam on the knolls and hillocks traversed by the dam and in the hill where the left flank of the dam rerts.

Blasting in such places will, while supplying first-class material for masonry, open out the foundations of the dam, and show at an early stage deviations from proposals which may be required, and further ensure that necessary blasting work which would be inconvenient and possibly dangerous at a later stage be got through before such stage is reached.

Among these works the approach road from the surplusing saddle to the left end of the dam and any other excavation above the dam on the steep hill on its left extremity should be included.

132. *Preliminary plans and programme.*—The details and organization of the work and of "preparatory works" require very careful study and arrangement by the officer who is selected to carry out the whole work.

It is on the work of these first two years more than on anything else that the subsequent progress of works will depend. The officer in charge must be given time to mature his plans and should not be urged into spending money prematurely or starting work on a great scale before the arrangements for organising the same are complete.

133. *Preliminary operations.*—The operations preliminary to commencing work alluded to in paragraph 132 will consist of preparing detailed plans and working drawings for roads and tram lines, bungalows, camps, workshops, power-house, stores, placing orders for first year's delivery of machinery, rails, rolling-stock, tools and plant, stock, road traction plant, firewood survey, sand and lime surveys, carrying out *works* as below:—

Building inspection bungalow and subordinates' quarters.

Improving road Erode to Metur.

Making forest roads.

Cutting firewood and conveying to site.

On this work will be posted the Engineer-in-Chief, who is to be entrusted with the construction, and two Assistant Engineers and four Upper Subordinates.

These operations will take at least a year which is not counted in the period of construction.

134. *Lists of miscellaneous preparatory works, and machinery and plant provided for.*—Lists of the special tools and plant and miscellaneous items provided for in the estimate which are most of them comprised in the "preparatory works" follow:—

HEAD WORKS—CAUVERY PROJECT.

MISCELLANEOUS ITEMS PROVIDED FOR IN THE ESTIMATES.

C.—Works.

		RS.	RS.
On the dam—			
Diversion works in river bed		80,000	
Pumping foundations		1,00,000	
Turbine pipes in the dam		24,000	
Closing construction sluices		15,000	
Yearly arrangements for surplusing during construction		90,000	
			3,09,000
K.—Buildings.			
Offices—Workshops and Stores, Public Works Department		52,000	
Quarters for staff, Public Works Department—	RS.		
Officers and Upper Subordinates ...	85,000		
Clerks and draftsmen...	18,000		
Peons and watchmen	6,000		
		1,09,000	
Inspection bungalow		9,000	
Housing of workmen—			
100 artificers and mechanics ...	40,000		
Workmen's camp with maintenance	3,10,000		
			3,50,000
Law and Police—			
Police Station—Cells—Treasury and quarters for Magistrate and Police		17,400	
Sanitation—			
Hospital with out-buildings and quarters for Medical staff		37,000	
			5,74,400

O.—Miscellaneous—Communications.

	RS.	RS.
Roads and railway tracks, construction, metalling, ballasting and up-keep (10 years)	3,15,000	
Sanitary Works and Maintenance Rs. 5,000 yearly...	50,000	
Water-supply—		
Installation of pumped and filtered piped supply ...	1,10,000	
Pumping and running expenses	40,000	
		5,15,000

P.—Maintenance.

Maintenance of works during construction (10,360 yearly)		1,03,600
Total ...		15,02,000

ESTABLISHMENT, OTHER DEPARTMENTS.

Permanent Staff chargeable against Works.

For 10 years—	
Medical officer and two assistants at Rs. 1,400 per month ...	1,68,000
Magistrate, Police Inspector, 30 constables at Rs. 600 per month	72,000
Forest officer and staff at Rs. 900 per month	1,08,000
Total ...	3,48,000

PROVISION FOR SPECIAL TOOLS AND PLANT.

Metur Dam and head works.

Central Power-station (300 K.W.) with motors, overhead line and lighting plant		2,12,500
Pumping plant		19,800
Mortar and surki making plant		1,84,500
Quarry and stone working plant		27,000
Cranes and lifting plant		1,20,000
Workshop machinery		30,000
Stone crushing and concrete mixing plant		86,200
Road traction plant		70,000
Water conveyance, steam launches and barges		2,00,000
Railway and Tramway—		
Track	2,77,000	
Wagons	1,03,000	
Locomotives	70,000	
		4,50,000
Unforeseen requirements		1,00,000
Total ...		15,00,000
Extra for machinery additional output of 100 units concrete per day with special arrangements for extra cost of installing by Telpher system of conveyance		5,60,000
Total, Tools and Plant ...		20,60,000

135. *Seasons of work and data of mason's works.*—For the purpose of arranging a distribution of work the year naturally divides itself into two seasons :—

I.—*The Dry Season* in which season only it is possible to work on No. I section of the dam which is used as a surplusing section.

II.—*The Flow Season* in which work on No. I section cannot be carried out.

Sections III to VI can be worked on at any time of year and no water will be met with even in foundations.

Section II can also be worked on at any time of year, but pumping will be required for foundations.

136. *Data for computing outturn of mason's works.*—In drawing out the programme of distribution of masons the space required for work has been considered.

Masons will work in gangs of two and each gang will be spaced not closer than 15 feet interval parallel to the length of the work and 20 feet interval at right angles, or when the dam is less than 40 feet wide two gangs per 15 feet spacing along the length of the dam.

The "preparatory works" are counted to take two years and to include excavating foundations for the deep section (I and II) of dam, and it is assumed in this programme that at the end of the second dry season these will be out, and that in II section work of building will commence in the last two months (November and December) of the second year.

Seasonal distribution of masons year by year.—In the tables of distribution of masons which follow the computations are only approximate showing a possible and reasonable distribution of mason's labour.

It is assumed that the average daily outturn of a mason is 40 cubic feet "hearting" and $22\frac{1}{2}$ cubic feet "facing". Combining and allowing for proportion of "facing" to "hearting" at 10 per cent the output per mason is computed at $38\frac{1}{2}$ cubic feet per day, and 24 working days per month is allowed for, that is, an output 9·24 units per mason monthly. In addition in the upper parts of the dam liberal allowances are given in an arbitrary way for the extra centage of face work.

137. *Normal date for commencement of dry season for purposes of masonry work.*—The actual date of possible commencement fluctuates with the character of the season. Taking 6,000 cusecs as the discharge which can be passed without interruption of work in the river-bed or on No. I section, it is found that frequently work can be commenced by about 15th November, but it is safer to count 1st December as the normal date.

One month is allowed for cleaning up the surface of the last season's work over which the water will have been surplusing for the whole "flow season" and for installing tram lines and cranes, etc., etc., and it is counted that the normal actual date of beginning of the building on No. I section is 1st January yearly.

138. *Normal date of cessation of "dry season" for purposes of masonry work.*—Reference to the discharges of Cauvery at Bhavani bridge for the last 28 years show that in only two years are floods exceeding 13,000 cusecs passed before the 10th June and with few exceptions discharges exceeding 11,000 cusecs are not passed before 15th June.

Further (with one exception) no flood exceeding 6,000 cusecs passed before 15th May.

In the first four years of construction surplusing power is restricted in capacity to 6,000 cusecs and flow can only be passed to this amount without interference with work in the river bed.

For these years the 15th May is considered the end of the "Dry Season".

After the fourth year surplusing power is increased greatly and from the fifth year the 15th June is counted as the end of the "Dry Season".

139. *Forecast of expenditure.*—The forecast of expenditure as shown in the attached table allows in the first four years for very large expenditure on machinery and plant of all kinds and on "stock".

In the first two years the preparatory works will be well advanced and from the end of the third year initial expenditure on these will be reduced to Small compass.

From the third year the execution of masonry work and collection and preparation of material will be the principal items of expenditure.

From the eighth year expenditure will gradually diminish and in the eleventh year the work will be most of it finishing up which takes a long time without entailing very great expenditure.

The twelfth year is devoted to sale and transfer of stores and plant and winding up generally.

Expenditure on sluice gates and on land compensation is allowed for the year before the sluice gates will be required or the land submerged.

Cauvery Reservoir Project Head Works.

Yearly distribution of expenditure.

Main heads.	Year and expenditure in thousands of rupees to nearest thousand.												Total.
	1	2	3	4	5	6	7	8	9	10	11	12	
Works, ordinary ..	8,79	9,58	17,70	16,36	20,35	20,35	20,35	15,35	11,35	9,35	5,34	2,00	1,56,87
Steel sluice gates and gear	..	..	43	..	98	..	2,87	4,04	..	..	..	..	8,32
Land ..	1,10	..	..	..	55	1,65	2,75	..	..	..	..	..	6,05
A. Direct charges—													
I. Works, Total ..	9,89	9,58	18,13	16,36	21,88	22,00	25,97	19,39	11,35	9,35	5,34	2,00	1,71,24
II. Establishment ..	2,01	2,52	4,44	4,09	5,10	5,07	5,30	4,26	2,94	2,48	1,32	52	40,05
III. Tools and Plant ..	2,62	4,43	4,75	4,34	3,00	1,50	1,00	60	40	30	8	3	23,05
IV. Suspense ..	50	1,50	1,00	— 40	— 40	— 40	— 40	— 20	— 20	— 20	— 10	— 20	+ 50
V. Receipts on Capital Account ..	..	— 3	— 5	— 5	— 5	— 5	— 5	— 5	— 13	— 50	— 1,00	— 1,56	— 3,52
Total, A. Direct charges ..	16,02	18,00	28,27	24,34	29,53	28,12	31,82	24,00	14,06	11,43	5,64	79	2,31,32
B. Indirect charges—													
Abatement of Land Revenue ..	40	..	..	..	20	60	1,02	..	..	..	..	..	2,22
Leave and Pension allowances, 14 per cent., on establishment.	28	35	62	57	72	71	74	60	41	35	19	7	5,61
Total, B. Indirect charges ..	68	35	62	57	92	131	1,76	60	41	35	19	7	7,83
Grand Total ..	15,70	18,35	28,89	24,91	30,45	29,43	33,58	24,60	14,77	11,78	583	86	2,39,15

140. *Tables of yearly distribution of masons and progress of masonry.*—The tables give a forecast of the details of distribution of masonry work and masons on the dam and the levels of masonry year by year and further the total quantities of masonry distributed throughout various sections of the dam.

In these tables to the end of the 4th year of construction the duration of the "Dry season" for purposes of masonry work is taken as 4½ months and after that as 5½ months.

CAUVERY RESERVOIR DAM AT METUR.

Abstract showing yearly distribution of masons.

Year and month.	Section of the dam and number of masons in each.						Total masons.
	I.	II.	III.	IV.	V.	VI.	
2nd year—							
November and December, 2 months	..	480	..	..	..	..	480
3rd year—							
Dry season—							
4½ { 1½ months	250	230	..	..	..	..	480
4½ { 1 month	320	160	..	..	..	..	480
4½ { 2 months	480	..	..	..	..	..	480
Flow season—							
7½ months	..	480	..	..	..	..	480
4th year—							
Dry season—							
4½ months	480	..	..	..	..	..	480
Flow season—							
7½ months	..	160	320	..	..	..	480
5th year—							
Dry season—							
5½ months	400	..	80	..	..	..	480
Flow season—							
6½ months	..	210	270	..	..	..	480
6th year—							
Dry season—							
5½ months	400	..	80	..	..	..	480
Flow season—							
6½ months	..	210	270	..	..	..	480
7th year—							
Dry season—							
5½ months	320	..	160	..	..	..	480
Flow season—							
6½ months	..	160	280	..	40	..	480
8th year—							
Dry season—							
5½ months	200	60	220	..	..	..	480
Flow season—							
6½ months	..	100	270	40	..	70	480
9th year—							
Dry season—							
5½ months	240	..	60	..	140	40	480
Flow season—							
3½ months	180	180	80	..	..	40	480
3 "	80	80	80	200	..	40	480
10th year—							
Dry season—							
5½ months	40	40	40	100	240	20	480

There will be work for most of the masons building parapets and finishing up generally throughout the 10th year and for a considerable number of men in the 11th.

Table showing levels of masonry in each section on months specified as per forecast.

Year and month.	Sections of dam and levels of masonry in each.					
	I	II	III	IV	V	VI
First and second year getting out foundations in I and II sections and preparatory operations of all kinds. Second year in November and December, masonry on foundations of II section will commence.						
2nd year— 31st December	..	+ 624	..	..	..	..
3rd year— 15th May	614	624	..	..	..	..
31st December	614	655	658	..	..	..
4th year— 15th May	630	655	658	..	..	..
31st December	630	666	674	..	..	..
5th year— 15th June	652	666	674	..	..	..
31st December	652	685	684	..	..	..
6th year— 15th June	672	685	687	..	..	..
	New irrigation commences. The 300 feet long notch in No. 1 section is built up flush with the rest of the section.					
31st December	672	705	700	..	..	..
7th year— 15th June	695	705	707	..	..	..
	The deep supply sluices can surplus up to 23,000 cusecs.					
31st December	695	724	724	..	..	..
8th year— 15th June	713	730	737	..	710	..
	Surplus water is taken over section V this flow season at level 710.					
31st December	718	745	765	730	710	760
9th year— 15th June	745	745	785	730	730	776
	This flow season floods taken over sections IV and V at level 730. No flow over section I. After end of September all flow taken through deep supply sluices and over section V and work on section IV put in hand. Construction sluices blocked up this dry season.					
30th September	775	775	785	730	730	788
31st December	793	793	793	760	715	793
10th year— 15th June	793	793	793	793	793	793
	Full capacity available for purposes of supply in tenth year and surplus passed through the main surplus sluices.					

Section I.

[The figures in parentheses (column 3) show the standard outturn of work of this number of masons.]

Year.	Months.	Number of masons.	Units of masonry.	Levels of masonry. From	To
3rd year— Dry season	1½	250 (3,465)	3,371	592	600
	1	320 (2,957)	2,890	600	605
	2	480 (8,870)	4,228 4,566	605	614
		15,292	15,055		
5th year— Dry season	4½	480 (19,958)	1,141 7,076 6,700 4,536	614	630
A notch 4 feet deep and 300 feet long left in this season.			19,453		

Section I—*cont.*

[The figures in parentheses (column 3) show the standard outturn of work of this number of masons.]

Year.	Months.	Number of masons.	Units of masonry.	Levels of masonry. From	To
5th year— Dry season	5½	480 (24,394)	5,888 5,712 5,636 5,230 1,984	630	652
			24,350		
6th year— Dry season	5½	400 (20,328)	2,977 4,729 4,496 4,264 1,612 1,649*	652	672
			19,727		
The 4-feet notch built up flush with rest of masonry. This flow season extension of irrigation commences.					
7th year— Dry season	5½	320 (16,263)	2,420 3,794 3,562 3,330 3,130	672	695
			16,236		
8th year— Dry season	5½	200 (10,164)	2,964 2,593 2,424 1,353	695	713
			9,334		
9th year— Dry season	5¼	240 (12,197)	903 2,087 1,918 1,750 1,575 1,395 1,215	713	745
			10,843		
Flow season	3½	180 (5,821)	1,035 889 776 664 551 189 270	745	775
			4,374		
Do.	3	80 (2,217)	450 450 450 270	775	793
			1,620		
10th year— Turning arches, etc.	..	..	..		

* To fill up 300-feet notch.

Section II.

[The figures in parentheses (column 3) show the standard outturn of work of this number of masons.]

Year.	Months.	Number of masons.	Units of masonry.	Levels of masonry. From	To
2nd year	Two months (November and [ecember).	480 (8,870)	4,450 3,990	+615	624
			8,440		
3rd year— Dry season	1¼ months .. 1 month ..	230 160 (4,666)	1997 3,597	+624	629
			4,594		

SECTION II—*cont.*

[The figures in parentheses (column 3) show the standard outturn of work of this number of masons.]

Year.	Months.	Number of masons.	Units of masonry.	Levels of masonry. From	Levels of masonry. To
3rd year—					
Flow season	7½	280 (19,404)	1,148 4,905 4,640 4,376 4,111	+ 629	650
			19,180		
4th year—					
Flow season	7½	210 (14,553)	4,686 4,455 4,223 852	+ 650	666
			14,216		
5th year—					
Flow season	6½	250 (15,015)	3,412 4,017 2,292 1,557 3,710	+ 666	685
			14,988		
6th year—					
Flow season	6½	210 (12,613)	3,450 3,227 3,041 2,856	+ 685	705
			12,574		
7th year—					
Flow season	6½	160 (9,610)	2,670 2,534 2,345 1,725	+ 705	724
			9,274		
8th year—					
Dry season	5½	60 (3,049)	430 1,965	+ 724	730
			2,395		
Flow season	6½	100 (6,006)	1,769 1,567 1,365	+ 730	745
			4,701		
9th year—					
Flow season	3½	180 (5,821)	722 462 1,048 915 827 687 235 336	+ 745	775
			5,232		
Do.	3	80 (2,217)	560 560 560 336	+ 775	893
			2,016		

Section III.

[The figures in parentheses (column 3) show the standard outturn of work of this number of masons.]

Year.		Months.	Number of masons.	Units of masonry.	Levels of masonry. From	To
3rd year—	Flow season	7½	200 (13,860)	10,452 3,000 — 13,452	+ 640	658
4th year—	Flow season	7½	270 (18,711)	2,001 5,058 6,077 5,589 — 18,725	+ 658	674
5th year—	Flow season	6½	230 (13,814)	1,357 6,936 5,443 — 13,766	+ 674	684
6th year—	Dry season	5½	80 (4,066)	1,360 2,544 — 3,904	+ 684	687
	Flow season	6½	270 (16,216)	3,819 6,212 5,951 — 15,982	+ 687	700
7th year—	Dry season	5½	160 (8,131)	5,824 2,185 — 8,009	+ 700	707
	Flow season	6½	280 (16,816)	3,281 5,109 4,752 1,811 1,664 — 16,617	+ 707	724
8th year—	Dry season	5½	220 (11,180)	994 4,150 3,771 1,352 — 10,267	+ 724	737
	Flow season	6½	270 (16,216)	2,030 2,993 2,604 2,276 2,009 1,742 — 13,654	+ 737	765
9th year—	Dry season	5½	60 (3,049)	1,474 527 715 — 2,716	+ 765	775
	Flow season	3½	80 (2,587)	1,150 1,122 — 2,272	+ 775	785
	Do.	3	80 (2,217)	1 122 673 — 1,795	+ 785	793

Section IV.

[The figures in parentheses (column 3) show the standard outturn of work of this number of masons.]

Year.	Months.	Number of masons.	Units of masonry.	Levels of masonry.
8th year— Flow season	6½	40 (2,402)	2,130	Up to 730
9th year— Flow season	Three months (October to December).	200 (5,544)	950 863 777 690 613 568 4,461	From 730 To 760
10th year— Dry season	5½	100 (5,082)	489 431 371 362 362 362 217 2,594	760 793

Section V.

[The figures in parentheses (column 3) show the standard outturn of work of this number of masons.]

Year.	Months.	Number of masons.	Units of masonry.	Levels of masonry.
7th year— Flow season	6½	40 (2,402)	2,034	From 698 To 710
9th year— Dry season	5½	140 (7,115)	1,278 1,183 639 1,043 1,614 5,757	710 730
10th year— Dry season	5⅓	240 (13,197)	1,452 1,286 692 428 204 841 918 802 686 570 195 279 465 465 465 279 10,027	730 793

Section VI.

[The figures in parentheses (column 3) show the standard outturn of work of this number of masons.]

Year.	Months.	Number of masons.	Units of masonry.	Levels of masonry. From	To
8th year— Flow season	6½	70 (4,204)	3,261	Up to 760	
9th year— Dry season	5½	40 (2,033)	612 539 493 29	760	776
			1,673		
Flow season	3½	40 (1,294)	430 458 275	776	788
			1,163		
Do.	3	40 (1,109)	183 275	788	793
			458*		

* Turning arches and finishing.

Distribution statement of quantity of masonry, Cauvery Dam, Metur.

Section I.

Level. From	Level. To	Depth.	Length.	Mean width of dam.	Contents of masonry.	Extra masonry for construction sluices.	Total masonry.	Total contents.
+ 592	+ 595	3	225	190·93	128,878	..	128,878	128,878
595	600	5	225	185·13	208,271	..	208,271	337,149
600	605	5	325	177·88	289,055	..	289,055	626,204
605	610	5	495	170·63	422,309	500	422,809	1,049,013
610	615	5	695	163·38	567,746	3,000	570,746	1,619,759
615	620	5	900	156·13	702,585	5,000	707,585	2,327,344
620	625	5	900	148·88	669,960	7,000 *6,982*	669,978	2,997,322
625	630	5	900	141·63	637,335	9,000 *27,788*	618,547	3,615,869
630	635	5	900	134·38	604,710	11,000 *26,933*	588,777	4,204,646
635	640	5	900	127·13	572,085	13,000 *13,857*	571,228	4,775,874
640	645	5	900	119·88	539,460	14,190	553,650	5,329,524
645	650	5	900	112·63	506,835	16,190	523,025	5,852,549
650	655	5	900	106·38	478,710	17,390	496,100	6,348,649
655	660	5	900	101·13	455,085	17,790	472,875	6,821,524
660	665	5	900	95·88	431,460	18,190	449,650	7,271,174
665	670	5	900	90·63	407,835	18,590	426,425	7,697,599
670	675	5	900	85·38	384,210	18,990	403,200	8,100,799
675	680	5	900	80·13	360,585	18,850	379,435	8,480,234
680	685	5	900	74·88	336,960	19,250	356,210	8,826,444
685	690	5	900	69·63	313,335	19,650	332,985	9,169,429
690	695	5	900	65·13	293,085	19,954	313,039	9,482,468
695	700	5	900	61·38	276,210	20,154	296,364	9,778,832
700	705	5	900	57·62	259,335	..	259,335	10,038,167
705	710	5	900	53·88	242,460	..	242,460	10,280,627
710	715	5	900	50·13	225,535	..	225,585	10,506,212
715	720	5	900	46·38	208,710	..	208,710	10,714,922
720	725	5	900	42·63	191,835	..	191,135	10,906,757
725	730	5	900	38·83	174,960	..	174,960	10,181,717
730	735	5	900	35·00	157,500	..	157,500	11,239,717
735	740	5	900	31·00	139,500	..	139,500	11,378,717
740	745	5	900	27·00	121,500	..	121,500	11,500,217
745	750	5	900	23·00	103,500	..	103,500	11,603,717
750	755	5	900	19·75	88,875	..	88,875	11,692,592
755	760	5	900	1[illegible]·25	77,625	..	77,625	11,770,217
760	765	5	900	14·75	66,375	..	66,375	11,836,592
765	770	5	900	12·25	55,125	..	55,125	11,891,717
770	772	2	900	10·50	18,900	..	18,900	11,910,617
772	775	3	900	10·00	27,000	..	27,000	11,937,617
775	780	5	900	10·00	45,000	..	45,000	11,982,617
780	785	5	900	10·00	45,000	..	45,000	12,027,617
785	790	5	900	10·00	45,000	..	45,000	12,072,617
790	795	3	900	10·00	27,000	..	27,000	12,099,617

Note.—Italic figures represent deductions.

Section II.

Level. From	Level. To	Depth.	Length.	Mean width of dam.	Contents.	Total contents
+ 615	+ 620	5	570	156·13	444,971	444,971
620	625	5	670	148·88	498,748	943,719
625	630	5	670	141·63	474,461	1,418,180
630	635	5	730	134·38	490,487	1,908,667
635	640	5	730	127·13	464,025	2,372,692
640	645	5	730	119 88	437,562	2,810,354
645	650	5	730	112·63	411,100	3,221,354
650	655	5	881	106·38	468,604	3,689,958
655	660	5	881	101·13	445,478	4,135,436
660	665	5	881	95 88	422,351	4,557,787
665	670	5	941	90·63	426,414	4,984,201
670	675	5	941	85·38	401,713	5,385,914
675	678	3	941	81·18	229,171	..
678	680	2	991	78·55	155,686	5,770,771
680	685	5	991	74·88	371,030	6,141,801
685	690	5	991	69 63	345,017	6,486,818
690	695	5	991	65·13	322,719	6,809,537
695	700	5	991	61·38	304,138	7,113,675
700	705	5	991	57 63	285,557	7,399,232
705	710	5	991	53·88	256,975	7,666,207
710	715	5	1011	50·13	253,407	7,919,614
715	720	5	1011	46·38	234,451	8,154,065
720	725	5	1011	42 63	215.495	8,369,560
725	730	5	1011	38·88	196,538	8,566,098
730	735	5	1011	35·00	176,925	8,743,023
735	740	5	1011	31·00	156,705	8,899,728
740	745	5	1011	27·00	136,485	9,036,213
745	748	3	1011	23·80	72,185	..
748	750	2	1061	21·80	46,260	9,154,658
750	755	5	1061	19·75	104,774	9,259,432
755	760	5	1061	17 25	91,511	9,350,943
760	765	5	1121	14·75	82,674	9,433,617
765	770	5	1121	12·25	68,661	9,502,278
770	772	2	1121	10·50	23,541	..
772	775	3	1121	10·0	33,630	9,559,449
775	780	5	1121	10·0	56,050	9,615,499
780	785	5	1121	10·0	56,050	3,671,549
785	790	5	1121	10·0	56,050	9,727,599
790	793	3	1121	10·0	33,630	9,761,229

Section III.

Level. From	Level. To	Depth.	Length.	Mean width of dam.	Contents of masonry.	Masonry for deep supply sluices. Length 370′.	Total masonry.	Total contents
+ 640	+ 645	5	425	119·88	254,745	..	254,745	254,745
645	650	5	545	112·63	306,917	..	306,917	561,662
650	655	5	909	106·38	483,497	..	483,497	1,045,159
655	660	5	989	101·13	500,088	..	500,088	1,545,247
660	665	5	1,055	95·88	505,767	..	505,767	2,051,014
665	670	5	1,341	90·63	607,674	..	607,674	2,658,688
670	675	5	1,348	85·38	575,461	119,100	694,561	3,353,249
675	680	5	1,355	80·13	542,881	150,749	693,630	4,046,879
680	685	5	1,486	74·88	556,358	123,995	680,353	4,727,232
685	690	5	1,486	69·63	517,351	118,990	636,341	5,363,573
690	695	5	1,486	65·13	483,916	137,240	621,156	5,984,729
695	700	5	1,486	61·38	456,053	139,087	595,140	6,579,869
700	705	5	1,561	57·63	449,802	132,612	582,414	7,162,283
705	710	5	1,561	53·88	420,533	126,137	546,670	7,708,953
710	715	5	1,561	50·13	391,265	119,662	510,927	8,219,880
715	720	5	1,561	46·38	861,995	113,187	475,182	8,695,062
720	722	2	1,561	43·75	136,588	44,548	181,136	..
722	725	3	1,621	41·88	203,662	62,164	265,826	9,142,044
725	730	5	1,621	38·88	315,122	99,895	415,017	9,557,041
730	735	5	1,621	35·00	283,675	93,420	377,095	9,934,136
735	740	5	1,621	31·00	251,255	86,945	338,200	10,272,336
740	745	5	1,621	27·00	218,835	80,470	299,305	10,571,641
745	750	5	1,621	23·0	186,415	73,995	260,410	10,832,051
750	755	5	1,621	19·75	160,074	67,520	227,594	11,059,645
755	760	5	1,621	17·25	139,811	61,045	200,856	11,260,501
760	765	5	1,621	14·75	119,549	54,570	174,119	11,434,620
765	770	5	1,621	12·25	99,286	48,095	147,381	11,582,001
770	772	2	1,621	10·50	34,041	18,648	52,689	..
772	775	3	1,621	10·0	48,630	22,872	71,502	11,706,192
775	780	5	1,621	10·0	81,050	33,970	115,020	11,821,212
780	785	5	1,621	10·0	81,050	31,167	112,217	11,933,429
785	790	5	1,621	10·0	81,050	31,167	112,217	12,045,646
790	793	3	1,621	10·0	48,630	18,700	67,330	12,112,976

Section IV.

Level. From	Level. To	Depth.	Length.	Mean width of dam.	Contents of masonry.	Masonry in central supply sluices.	Total masonry.	Total contents.
+ 722	+ 725	3	242	41·88	30,405	52,533	82,938	82,938
725	780	5	242	38·88	47,015	83,055	130,100	213,038
730	735	5	242	35·00	42,350	52,652	95,002	308,040
735	740	5	242	31·00	37,510	48,827	86,337	394,377
740	743	3	242	27·80	20,183	45,013	77,683	472,060
743	745	2	242	25·80	12,487			
745	750	5	242	23·00	27,830	41,188	69,018	541,078
750	755	5	242	19·75	23,898	37,363	61,261	602,339
755	760	5	242	17·25	20,873	35,938	56,811	659,150
760	765	5	242	14 75	17,848	31,093	49,941	708,091
765	770	5	242	12·25	14,823	28,288	43,111	751,202
770	772	2	242	10·50	5,082	15,137	37,109	788,311
772	775	3		10·00	7,260	9,630		
775	780	5	242	10·00	12,100	24,075	36,175	824,486
780	785	5	242	10·00	12,100	24,075	36,175	860,661
785	788	3	242	10·00	7,260			
788	790	2	242	10·00	4,840	24,075	36,175	896,836
790	793	3	242	10·00	7,260	14,445	21,705	918,541

Section V.

Level. From	Level. To	Depth.	Length.	Mean width of dam.	Contents of masonry.	Total contents.
+ 698	+ 700	2	300	60·25	36,150	36,150
700	705	5	300	57·63	86,445	122,595
705	710	5	300	53·88	80,820	203,415
710	715	5	510	50·13	127,832	331,247
715	720	5	510	46·38	118,269	449,516
720	722	2	730	43·75	63,875	617,672
722	725	3	830	41·88	104,281	
725	730	5	830	38·88	161,352	779,024
730	735	5	830	35·00	145,250	924,274
735	740	5	830	31·00	128,650	1,052,924
740	743	3	830	27·80	69,222	1,164,974
743	745	2	830	25·80	42,828	
745	746	1	830	24·60	20,418	1,269,464
746	750	4	930	22·60	84,072	
750	755	5	930	19·75	91,837	1,361,301
755	760	5	930	17·25	80,212	1,441,513
760	765	5	930	14·75	68,588	1,510,101
765	770	5	930	12·25	56,963	1,567,064
770	772	2	930	10·50	19,530	1,614,494
772	775	3	930	10 0	27,900	
775	780	5	930	10·00	46,500	1,660,994
780	785	5	930	10·00	46,500	1,707,494
785	790	5	930	10·00	46,500	1,753,994
790	793	3	930	10·00	27,900	1,781,894

Section VI.

Level. From	Level. To	Depth.	Length.	Mean width of dam.	Contents of masonry.	Masonry in right supply sluices.	Total masonry.	Total contents.
+ 736	+ 740	..	..	..	..	50,306	50,306	50,306
+ 740	+ 743	3	224	27·80	18,682	58,457	88,697	139,068
743	745	2	224	25·80	11,558			
745	750	5	224	23 00	25,760	24,500	50,260	189,263
750	755	5	404	19·75	49,770	22,248	72,018	261,281
755	756	1	504	18·25	9,198	20,002	64,832	326,113
756	760	4	524	17·60	35,632			
760	762	2	524	15·50	16,244	20,827	61,182	387,295
762	765	3	564	14·25	24,111			
765	770	5	564	12·25	34,545	19,343	53,888	441,183
770	772	2	632	10·50	13,272	17,092	49,324	490,507
772	775	3	632	10·0	18,960	..	..	
775	776	1	632	10·0	31,600	2,892	2,892	493,399
776	780	4	632			11,392	42,992	536,391
780	785	5	632	10·0	31,600	14,240	45,840	582,231
785	788	3	632	10·0	18,960	14,240	45,840	628,071
788	790	2	632	10·0	12,640			
790	793	3	632	10·0	18,960	8,544	27,504	655,575

SECTION VI.

Grand Anicut System—Main and Branch Canals.

A.—*General.*

141. *Vernacular terms used.*—In the description of the proposed irrigation system following, it is necessary to use a few vernacular terms which, added as suffixes to the local names, frequently form an integral part of such names.

The terms used are as below :—

Tank	Eri or kulam.
Small stream or drainage	Vari.
River	Ar.

The irrigated area supplied by a work is termed its "ayacut."

142. *System of reduced distances and mileage adopted.*—The system of "Reduced distance" adopted for main canals and for branch canals is the measurement in feet from the head regulator of the main or branch canal concerned.

In order to obviate the inconvenience of dealing with very large numbers, an independent unit of 10,000 feet termed a "Hecto-chain" (being 100 chains of 100 feet each) is generally used as a notation in the fractional form thus R.D. 7/0860 instead of 70,860 feet.

The survey plans furnished are to a scale based on "inches to a statute mile." All Madras Presidency irrigation works and roads are subdivided into statute miles and fractions of this.

For these reasons, after careful consideration, it has not been considered desirable to introduce a 5,000 feet mile, an alternative which has, on other grounds, much to recommend it ; the system of "Hecto-chains" which has been adopted attains the same advantages without the drawbacks inherent from the use, under the term "mile," of a length differing from the "Statute mile."

All "Reduced distances" (R.D.) in main canals and branches are noted either in "Hecto-chains" and chains (of 100 feet) to two places of decimals, thus 7/08·60, or on "Hecto-chains" and feet thus 7/0860.

On longitudinal sections statute miles, half and quarter miles are also noted for convenience in cross reference with the connected survey plans.

143. *System of nomenclature of branches and distributaries.*—The following system of naming canals and channels has been followed :—

(*a*) Main canals and branches are termed "canals", while all distributaries are "channels."

(*b*) Every Government channel below its lowest point of subdivision is distinguished by both a name and a number.

The name is that of the "parent" canal or channel in which its head is situated.

The number is given to each such off-take in consecutive order from the head of that "parent" canal or channel.

(*c*) Every other canal or channel is given a distinctive name, generally that of a village dependent on it for supply of water for irrigation.

Example.—No. 5 Grand Anicut channel signifies a channel (fifth in order of such channels from the Head Regulator) off-taking direct from the Grand Anicut canal and not subdivided below its head by the off-take of any other Government channel.

144. *General remarks on character of tract to be irrigated.*—The map of the "Irrigated area" shows the country consists of a series of long narrow spurs running generally north-west to south-east and along the crest of these spurs the distributary system channels are aligned.

From spur to spur the width is generally from $1\frac{1}{2}$ to 3 miles, and the intervening valley and drainage course provides an efficient natural drainage, which is not obstructed by the proposed works.

The general slope of the country towards the sea is from 5 to 10 feet a mile and this corresponds with the fall of the crests of the spurs.

The sides fall much more steeply and frequently as much as 30 feet a mile.

The soil throughout the area is of the same nature, viz., a red or yellow loam with a large admixture of coarse sand.

This soil on the surface presents so sandy an appearance as to suggest a very absorbent nature. This is, however, only the result of the carrying off by surface flow of the retentive clayey constituents of the soil. As a fact the sub-soil, although not absolutely impervious, is so retentive of water that even on the top of ridges there are numerous small irrigation wells all over the tract giving water at depths from the surface varying from 5 to 15 feet. With the exception of a lateritic formation running on and to the west of the alignment Tanjore, Gandaracottah and Arantangi there is no stone in the tract except nodular limekunkur which is found in pockets here and there all over the tract a few feet below the ground surface, and especially in the beds of streams.

The soil is easy to work and well suited for irrigation, while the people are eager to grow wet crops and understand this culture.

145. *General conditions at the Grand Anicut.*—The Grand Anicut canal system will have its head in the right bank Cauvery and is designed to be built nearly at right angles to the existing Vennar regulator and in close proximity to that work.

A plan following paragraph 11 shows the existing works at the Grand Anicut. No alteration is proposed to these or to the general water levels maintained for the distribution of the water at the Grand Anicut.

Under existing arrangements full supply in the Vennar is the same level as the proposed full supply of the Grand Anicut canal, viz., 7 feet above the cill level of Vennar regulator. The level to be maintained in future above these regulators will be that hitherto maintained for passing full supply into the Vennar.

Under present conditions, when sufficient water is not available for passing simultaneous full supply through both the Cauvery and Vennar regulators, a system of "turns" obtains, and full supply is passed in rotation, for the turn period, to each system.

As full supply in Cauvery is 4·5 feet it is unnecessary, and also unusual, to hold up water to 7½ feet to pass full supply to this river and consequently the 7½ feet depth is only maintained under such conditions on the "Vennar turn days."

As the Grand Anicut canal system is designed for continuous flow, it will in the future be necessary to hold up water above the Grand Anicut continuously to about 7½ feet, instead of doing so as at present, for a few days each week during periods of deficient flow in the main river. It is not considered that such an alteration will cause any material alteration in the condition of regime of the river above the Grand Anicut. The new conditions will indeed nearly assimilate to those now obtaining on a year of plentiful and well-distributed flow.

146. *Head regulator.*—The head regulator is designed to be capable of passing full supply (4,120 cusecs) with water standing in front of the work at +193·41 (G.T.S.), the cill of the Vennar regulator being +185·91.

The F.S.L. in rear of the new regulator is +192·91 and the bed level +195·91.

It is proposed that the cill of the new regulator shall be at +188·91, that is, 3 feet above the canal bed in rear. The work proposed is to be 8 spans of 30 feet.

Thirty feet is the length of the main spans of the adjoining Vennar and Cauvery regulators and the proposed work is designed to be in keeping with, and of general character and features, similar to these works.

It is proposed that the openings in the regulator shall be 30 feet by 4 feet, that is, the top of the openings shall be on a level with the F.S.L. in the canal. The shutters to run on Stoney rollers and are to be capable of being raised clear or lowered 3½ feet. The object of this is to enable water to be taken off for the canal over the tops of the shutters at as high a level as possible.

Immediately on passing through the regulator, the canal will curve sharply round to the left and run parallel to the existing Vennar for 4 miles. Immediately below the head it crosses the old Vennar, which now carries upland drainage off 83 square miles of catchment into the Vennar below the regulator.

147. *Diversion of the old Vennar.*—It is proposed to cut this drainge out into the main river (the Cauvery) just above the new regulator.

The maximum flood level recorded at the Grand Anicut above the work is + 197·2, while the level of the lowest fields under the Kiliyur channel draining into the old Vennar is 196·4.

The proposed diversion can therefore be made without exposing cultivated lands to damage by submergence and this being so the arrangement is a distinct improvement on the existing one.

This will give greater power of disposing of the local drainage than now exists; under the present circumstances it must be received into the Vennar below the regulator and must be passed down that river whether the supplies are wanted or not.

In the future there will be the option of surplusing, through the Grand Anicut into the Coleroon, or passing into either the Cauvery, or Vennar, or into the new Grand Anicut canal, as may be most desirable. The drainage of the wet fields between the Cauvery and the old Vennar and also irrigation supply for 220 acres of land on the left side of the Vennar is now carried under this river through the Thogur irrigation and drainage syphon. This work will be prolonged to pass under the new canal and continue to serve as heretofore for this area.

A combined irrigation and drainage syphon will be provided under the new outfall out of the old Vennar drainage to connect with the above work.

148. *Grand Anicut canal.*—Below the crossing of the old Vennar the new canal left bank and the Vennar right bank will be one. The actual cutting of the canal will not follow the minor sinuosities of the Vennar, but the left berm will vary in width to rectify these. At Kiliyur village in the 3rd mile the canal makes a curve leaving the village between the Vennar and the new work and here a bridge is provided. After passing the village, the canal again is carried close along the right side of the Vennar up to Indalur tank.

R.D. 0 to 3/4220.

This tank now receives a supply from the Vennar as well as from the Wyacondan.

The former supply will now be cut off and irrigation of the lands between the new canal and the Vennar supplied direct from the new canal. The lands on the right of the canal and on the left of the Adappampolem drain will continue to be supplied from the Indalur tank and for this purpose a new high level sluice in the tank must be provided to replace that cut off by the new canal from the fields it irrigates. The Adappampolem drain is to be cut out into the Vennar by the shortest line from the place where the new canal crosses it and it must be banked on both sides from the syphon aqueduct on the new canal to the Vennar flood bank. This cut will ensure a good outfall for the new syphon, while this drainage now surplusing, into and out of Ananda Cauvery, to which channel it does much damage in floods, will now be diverted away from it. The wet cultivation lying between the old Vennar and the Indalur tank and supplied by Kiliyur irrigation channel which runs on the right of the new canal alignment now drains, when the Vennar is low, through small sluices into that river. This drainage will be carried along a side drain cut clear of the right bank of the new canal into Indalur tank, the full supply level of which is lower than the fields to be drained.

This will necessitate deep cutting and a culvert in connexion of the bridge over the canal at Kiliyur village but it is the most economical and effective way of dealing with the question.

The canal crosses the Adappampolem drainage over a sypon aqueduct and runs below Indalur village and through the bed of the small tank (21 acres) which will be abandoned, all the irrigation on the right side of the above drainage below the

new canal in Indalur village will be supplied direct from it by a sluice on the boundary between this village and Kadambangudi. The lands in this village wil be supplied from the same sluice.

A diversion of alignment made at a late date between R.D. 2/8220 and R.D. 2/8750 introduces a "long chain" error of 330 feet into the total distance. This has been allowed for in estimating but not in water or bed levels, the difference caused being insignificant.

The canal now runs for the most part through the upper part of the beds of Government tanks for the next 2½ miles.

The first of these tanks Veppangudi tank is a shallow rain-fed tank.

It is proposed to supply the tank from the new canal and divert the drainage from the catchment 2·0 square miles by a catch drain into Solingampatti Vari.

The next tank is Marneri, a tank having a supply channel from the Vennar, and a free catchment area of 1·0 square mile. This tank could easily be supplied from the new canal. It is however proposed to abandon it, as it has an area of 320 acres and the ayacut is only 357 acres, and to irrigate both tank bed and ayacut from the canal. This area will be irrigated from No. I distributary channel which off-takes at R.D. 3/4220.

The drainage from the catchment area will, as in the case of the previous tank, be diverted into Solingampatti Vari.

R.D. 3/4220 to 5/4949.

A "C" class bridge will be provided for the cart-track at R.D. 3/9453 between Marneri tank and Soligampatti Vari.

The Solingampatti Vari at R.D. 4/0784 is the most important cross drainage on the section of the canal above Tanjore and will be passed under the canal by a syphon aqueduct of 18 spans of 12 feet.

Immediately after crossing this, the canal passes under the South Indian Railway which will have to be raised about 6 feet to give sufficient headway. The bridge is designed by the Railway authorities to be 4 spans of 50 feet.

The canal now runs round the foreshore of Kangayampatti tank (ayacut 249 acres). The level of the tank bed is so high that it is impossible to pass the drainage supplying the tank into it and under the canal, without providing a sypon so deep the great danger of silting would result. It is considered unwise to syphon the canal so near the head.

For these reasons, the tank is to be supplied from the new canal and the drainage syphoned under the canal by a syphon aqueduct of 7 spans of 6 feet at R.D. 4/7562.

It is proposed to make for a short diversion of the drainage channel on this crossing, so that the run-off channel in rear may discharge outside the tank bund without interfering with the tank and the weir.

From here the canal passes below two small tanks Pudu Eri 23 acres, and Ralpidi Eri 30 acres, and the small area of wet lands thus cut off must be supplied direct from the canal.

A foot bridge is proposed at R.D. 5/1220, i.e., in the boundary between Kangayampatti and Nandavanampatti.

On approaching the next drainage (Aiyanapuram Vari), the canal crosses the upper part of the beds of the two tanks, Agapathu Eri (23 acres) and Solagan Eri (50 acres). These tanks will be supplied from the canal and their catchment diverted into the Aiyanapuram Vari.

A "C" class bridge is provided at R.D. 5/4949.

R.D. 5/4949 to 7/1150.

The Aiyanapuram Vari is passed under the canal by a syphon aqueduct of 8 spans of 12 feet (R.D. 5/5070). After crossing, this canal runs through the ayacut of Periakulam and an irrigation sypon under the canal for 190 acres is required here (about R.D. 5/6220).

The cross drainage of Nandavanampatti Vari is passed under the canal (R.D. 5/9750) through a syphon aqueduct of 7 spans of 6 feet.

In the left wall of this aqueduct 7 lift shutters 6 feet span are fitted forming a powerful "surplus sluice" in combination with this aqueduct.

From this the canal runs successively through three tanks Melakudi Eri (2 acres) which will be abandoned, Edakudi Eri (71 acres) which will be supplied from the canal by a sluice at R.D. 6/2000, and Mudhalai Kuruchi Eri (97 acres) which will be abandoned and whose ayacut will be served by the proposed sluice at R.D. 6/6720.

The drainage from the catchment of all these tanks will be diverted back into the Nandavanampatti Vari. The discharge of the small stream (·8 square mile catchment) crossed at R.D. 6/9270 will be similarly dealt with.

The ayacut of the Kudikath Eri cut off from its catchment will be supplied by the proposed sluice at R.D. 6/6720.

The "C" class bridge will be provided at R.D. 6/2000.

The canal now enters (R.D. 6/8000) the Budalur cutting which is 2 miles long.

R.D. 7/1150 to 9/7500.

A "B" class bridge is provided at the road crossing the canal line at Budalur Railway station R.D. 7/1150.

The canal here runs in cutting close to and paralled to the railway.

There are a number of small cross drainage works on the railway in the 2 miles east of Budalur station.

It is proposed to collect and divert these in a catch drain along the right side of the canal bank to the drainage at R.D. 8/6247 where the canal is carried with bed 7 feet out of ground.

The Chief Engineer, South Indian Railway, has considered the proposals and does not consider that the railway cross drainage work below this need be enlarged or supplemented to take the extra catchment thus diverted through it.

The tanks Ammal Eri (53 acres), Vanyan Eri (55 acres) and Periya Eri of Sithirakudi (102 acres) cut off by the canal from their catchment will be supplied with water from the canal by supply sluices at R.D. 7/6197 and 8/0747.

From the latter sluice No. 2 distributary channel will take off for 497 acres.

A road bridge "C" class will be provided R.D. 7/7912 and the cart-track which now runs up the drainage course must be diverted as shown on the plan and longitudinal section.

The Sitharakudi Vari is crossed at R.D. 8/6247 by a syphon aqueduct with 8 spans of 6 feet.

The canal now runs through the Alakudi ridge.

A distributary named "Chukkura Sammanthan channel" for irrigating 4,179 acres lying most of it north of the railway will here offtake (R.D. 8/9647).

A "C" class bridge is provided at R.D. 9/0375.

After passing through the ridge, two sluices on the left bank for new irrigation one on each side of the Muthalai Muthu Vari will be required.

The minor drainage channels crossed between R.D. 9/5900 and Muthalai Muthu Vari will be diverted by a side channel into the latter stream.

No. 3 distributary channel (926 acres) will take off at R.D. 9/7500.

R.D. 9/7500 to 12/8899.

The Muthalai Muthu Vari is passed by syphon aqueduct of 10 spans of 12 feet R.D. 10/0049. This is the second largest drainage above Tanjore. After crossing this stream, the canal runs across the flat land on the right of it between it and the Vallam ridge, and then, turning northward runs along the side of the ridge and crosses the railway close to Tanjore town.

A "B" class bridge is provided at R.D. 10/2500 carrying the Vallam Alakudi road over the canal. The Krishnasawmi Naicken tank (23 acres) is to be filled from the canal by a sluice at R.D. 10/4050.

The intercepted catchment areas from R.D. 10/5500 are to be diverted back along the canal into Muthalaimuthu Vari through a side channel.

No. 4 channel (572 acres) will take off at R.D. 10/6881.

All along the side of Vallam ridge the canal intercepts a number of small drainages but none of these are irrigation sources.

The largest and most suitable of these is passed under the canal by a syphon aqueduct with 5 spans of 6 feet (R.D. 11/2430).

The smaller drainages are diverted into this as shown on the longitudinal section.

No. 5 channel (425 acres) takes off R.D. 11/7219.

A foot bridge is provided at R.D. 11/8581.

Below this foot bridge the canal will cross four small drainage courses and these will all be collected into one at R.D. 12/0970 where a syphon aqueduct with 4 spans of 6 feet will be provided, this being the place where the biggest culvert (3 spans of 15 feet) is provided on the railway line.

Below this cross drainage work the canal will run in cutting (maximum 12 feet) through the Ramarathapuram ridge. This cutting is necessary not only to avoid the high embankment involved by going below the village but also to secure headway on the railway crossing at R.D. 12/3450.

This crossing will be on the skew and the waterway provided as per design furnished by the Railway authorities is 7 spans of 40 feet and the work involves raising the rail level 4 feet.

A "C" class bridge is proposed at R.D. 12/4079 for the cart-track that leads to Ramanathapuram village.

After passing through the Ramanathapuram ridge the canal will cross the Reddipolem vari and for this syphon aqueduct with 5 spans of 6 feet is proposed at R.D. 12/5569.

This syphon aqueduct will be located on a straight cut proposed for the vari and this cut will join the old course 900 feet below the canal crossing.

All the drainages between this and the Seppu Naicken tank (close to Tanjore fort ditch) will be diverted to the syphon aqueduct proposed above.

R.D. 12/8899 to 14/4355.

The canal will now enter the Tanjore town cutting. The commencement of the cutting will be at R.D. 12/8899 where the bed of the canal will be gradually lowered 3 feet in order that the depth of water may be increased from 7 feet to 10 feet and the width of excavation reduced. In this portion the fall of the canal will also be increased from 0·15 per 1,000 to 0·205 per 1,000 and the bed-width of 172 feet with 7 feet depth will be reduced to 84 feet with 10 feet depth.

The Seppu Naicken tank supply channel will be crossed at R.D. 13/1719 on the skew, and, as the bed of the tank supply channel will be more than 19 feet above the proposed bed of the canal a super-passage over the canal has been provided.

The width of waterway allowed for the super-passage is 18 feet, as the supply channel enters the tank through an inlet with an aggregate waterway of 16′ 9″.

The waterway provided for the canal is 3 spans of 27 feet.

Passing under the supply channel to Seppu Naicken tank the canal will enter the Tanjore Fort South Ditch at R.D. 13/3199 run along the ditch for a length of 1,500 feet with its bed 3 to 4 feet lower than the existing bottom level of the ditch and pass out of the ditch at the Vallam road crossing at R.D. 13/4907. Here a "special class" bridge 45 feet wide will be constructed to suit the requirements of the traffic in the Tanjore town.

Crossing the Vallam road the canal will run behind the Taluk cutcherry and the Collector's office and through the Muhammadan burial-ground which will be split up into two portions. In order to connect the two portions of the burial-ground a foot bridge is proposed at R.D. 13/6540. The Thekkal tank will be absorbed by the canal and steps will be provided for the canal to facilitate bathing in canal water.

Passing through the Thekkal tank, the canal will cross the railway station road at R.D. 13/6768 where a bridge 66 feet wide will be provided to suit the very heavy traffic.

Immediately after the above road crossing there is a drainage channel which will be absorbed by the canal and an inlet provided at R.D. 13/6850.

A small surplus sluice with a vent 5 feet by 5 feet will be provided on the left bank at this place for the purpose of surplusing excess water when required.

The Rangasamudram tank also will be absorbed by the canal at R.D. 13/7400. The "Resident's Bungalow road" will be cut off by the canal and no bridge is proposed here as there will be roadway on both banks of the canal to form connection with "Cadell's Road."

The canal will then pass through the southern portion of the compound of Resident's Bungalow and cross "Cadell's Road" at R.D. 13/8890 where a special class bridge 36 feet wide will be provided.

Passing Cadell's Road the canal will run through the compound of the Jubilee bungalow and behind the Executive Engineer's bungalow. The small drainage channel at R.D. 13/9500 will be diverted towards the next drainage channel. The canal will then cross the "Negapatam Road" at R.D. 14/0150 where a "special class" bridge will be provided. The small drainage channel that is crossed at the road crossing will be absorbed by the canal above the road bridge and a second inlet provided at R.D. 14/0090. Opposite this inlet on the left bank a second surplus sluice with one vent 5 feet by 5 feet will be provided for the purpose of surplusing excess water when required.

The South Indian Railway will be crossed at R.D. 14/0740 on the skew and the waterway provided in the design by the Railway authorities is 3 spans of 50 feet.

Below the crossing of the railway a cart-track is crossed at R.D. 14/1640 where a combined bridge and regulator is proposed for the purpose of holding up water in the canal during closure. The bed of the canal will be gradually raised in a length of 440 feet so that the floor of the bridge and the sill of the regulator may be at the higher bed level.

All the masonry works in the Tanjore town are proposed to be constructed with surki mortar as water will be impounded here even during closure and it is desirable that highly hydraulic mortar should be used.

The canal will then cross the drainage at the municipal boundary where a syphon aqueduct with 2 spans of 4 feet will be provided (R.D. 14/2096).

Another drainage is crossed at R.D. 14/3930 where a syphon aqueduct with 3 spans of 4 feet is proposed.

Further details of the provisions and arrangements proposed for the length of main canal in Tanjore town are given under "Technical" (para. 195).

R.D. 14/4355 to R.D. 23/3000.

The canal will cross 2 drainages at R.D. 14/6200 and at R.D. 14/7500. These will be combined into one and a syphon aqueduct provided at R.D. 14/6200 with 3 spans of 6 feet by 6 feet. A small supply channel to a pond will be cut off near Pudupatnam village and the pond will be supplied by a sluice at R.D. 14/7500. The Neivasal Tenpadi channel will take off at R.D. 14/9160 for irrigating 8,160 acres. The supply channel to Vastad Savadi Eri will be cut off at R.D. 15/0280 where a supply sluice will be provided on the left side.

A "C" class bridge will be provided at R.D. 15/3100 for the cart-track from Kandudampatti to Raramuthrakotta.

The canal will then pass through the bed of Kadambara Eri (ayacut 160 acres) which will be absorbed and whose ayacut served by a sluice at R.D. 15/3700. The surplus channel from Kadambara Eri will be crossed at R.D. 15/5250, where a syphon aqueduct will be provided with 3 vents of 4 feet by 5 feet. The Vadacherri channel will take off at R.D. 15/8000 for irrigating 14,768 acres.

R.D. 15/8000 to R.D. 17/3000.

Two drainages are crossed at R.D. 15/8750 and at R.D. 16/0540, and as these enter two different valleys and supply some tanks, it is not proposed to combine them into one. At R.D. 15/8750 the canal will be passed under the drainage by a

syphon with 8 vents of 12 feet by 6 feet, and at R.D. 16/0540 a syphon aqueduct will be provided with 3 vents of 4 feet by 5 feet. Between these two at R.D. 15/9800 the biggest branch canal, the Kaliyanodai branch, will take off for 87,819 acres, and just below the off-take a regulator is provided at R.D. 15/9900 with 15 vents of 6 feet width and 7 feet height each, so as to pass the required supply with a head of 0·50 foot. The depth of water in the canal below this regulator is reduced to 6·5 feet. Above this regulator and just below the canal syphon, a surplus sluice at R.D. 15/9050 is provided with 8 vents each 6 feet × 7 feet to discharge 2,352 cusecs, the full discharging capacity of the regulator.

A "C" class bridge will be provided at R.D. 16/4040 near Kandudampatti village, and the other tracts that are cut off will be connected with this bridge by the roads that will run along both banks of the canal.

Below Kandudampatti village the canal will cut off a number of small drainage channels which supply small tanks. These will all be diverted to the nearest cross-drainage work as shown in the longitudinal section, and tank supply sluices provided at R.D. 16/5400, 16/6740 and 17/0820. No. 6 channel will take off at R.D. 16/8500 for 1,018 acres. An important drainage is crossed at R.D. 17/3200 and a syphon aqueduct with 3 vents of 6 feet by 6 feet will be provided here. A sluice to supply Koilur, Tirumani and Alangayya Kulam will be provided at R.D. 17/4900.

R.D. 17/3000 to R.D. 18/8000.

A "C" class bridge will be provided at R.D. 17/6335. No. 7 channel will take off at R.D. 17/6468 for 1,250 acres. The canal will then pass below Serukudiyan Eri, and through the bed of a ruined tank close by, and an irrigation syphon is proposed at R.D. 17/8580 to pass the tank supply to its ayacut. The drainage course at R.D. 18/0980 will then be crossed by a syphon aqueduct with 5 vents of 6 feet by 6 feet, and the adjacent minor drainages diverted to this work as shown in the longitudinal section. A "C" class bridge will be provided at R.D. 18/4900. No. 8 channel will take off at R.D. 18/2000 for 1,247 acres. A syphon aqueduct with 4 vents of 4 feet by 5 feet each will be provided at R.D. 18/6450, and the adjacent minor drainages diverted into it.

A sluice for the direct irrigation of 340 acres will be provided at R.D. 18/9000.

R.D. 18/8000 to R.D. 20/3000.

A "B" class bridge will be provided at R.D. 19/2000. The Rajamadam branch will take off at R.D. 19/2500 for 25,780 acres. Immediately below the head of this branch a regulator with 13 vents each 6 feet wide will be provided in the canal and the depth of water in the canal below this regulator will be reduced to 6 feet, at full supply.

The three minor drainages above the head of Rajamadam branch will be diverted to the syphon aqueduct at R.D. 18/6450. A syphon aqueduct is provided for at R.D. 19/3165. A sluice for the direct irrigation of 190 acres is proposed at R.D. 19/3500. The next drainage that is crossed is at R.D. 19/9150 and a syphon aqueduct with 4 vents of 6 feet by 6 feet is proposed here. The small drainages at R.D. 19/9600 and 20/1700 will be diverted towards this work. No. 9 channel for 700 acres will take off at R.D. 20/0500.

From 20/3000 to 21/8000.

A "C" class bridge will be provided at R.D. 20/5250, and the Sillathur channel will take off at R.D 20/6000 for 6,201 acres. The canal will then run below Karuppadipatti tank and cross its surplus channel at R.D. 20/7600. An irrigation syphon will be provided at R.D. 20/7000, and a syphon aqueduct with three vents of 4 feet by 4 feet at R.D. 20/7600.

No. 10 channel for 400 acres will take off at R.D. 21/0000. A "C" class bridge will be provided at R.D. 21/4000.

R.D. 21/8000 to R.C. 23/3000.

The canal will then cross the Kattar, a tributary of the Maharajasamudram river, at R.D. 21/8750 by a syphon aqueduct of 9 vents of 12 feet by 6 feet. A small portion of Attangaraipatti tank will be cut off by the canal between R.D. 21/7950 and R.D. 21/8200, and in this length the canal right bank will itself be made to serve the purpose of tank bund. After crossing the Kattar, the canal will run through the wet lands irrigated under certain tanks. In this length the sub-soil

water level is high and rises very nearly to ground level. The canal is aligned along the foreshore of the Olavayal and Keerathur tanks, and, as it is not possible to provide cross-drainage works with suitable outfall levels on account of the close proximity of the tanks, it is proposed to provide supply sluices to the tanks and to divert all up-land drainage on one side into the Kattar and on the other side into the Maharajasamudram as shown in the longitudinal section. No. 11 channel will take off at R.D. 22/3000 for 994 acres. Supply sluices to Olavayal tanks will be provided at R.D. 22/3200 and 22/5000.

A "C" class bridge will be provided at R.D. 22/6700. A supply sluice for Keerathur tank will be provided at R.D. 22/9000. The canal will now approach the Maharajasamudram river in embankment, and for about 2,500 feet, the bed of canal will be 2 to 2½ feet out of soil. This embankment is necessary in order to get the requisite headway at the Maharajasamudram crossing.

R.D. 23/3000 to R.D. 24/8630.

The canal will cross the Maharajasamudram at R.D. 23/3360 by a syphon aqueduct with 14 vents of 12′ × 6′. The surplus channel from the Reghunathapuram tank will be crossed at R.D. 23/6000 by a syphon aqueduct with 4 spans of 6′ × 4′. The canal will then run below the Reghunathapuram tank and through the tank ayacut, crossing the irrigation channels from the tank at R.D. 23/7130 and R.D. 23/7700 where irrigation syphons will be provided. At the right flank of the Reghunathapuram tank there is another surplus escape, and the surplus channel on this side will be crossed by the canal at R.D. 23/9000. No cross-drainage work is proposed here, as the surplus escape may be closed and the entire surplus passed through the escape at the left flank. The Kallimadai channel will take off at R.D. 23/9130 for 2,000 acres. The canal will then run in cutting through the saddle between Puduviduthi and Pappapatti from R.D. 23/9130 to R.D. 24/5630. The maximum depth of cutting is only 7·69 and the sub-soil to be cut through is chiefly red loam, except near the left flank of the Pappapatti tank where gravel is met with at 5½′ below G.L. A "C" class bridge will be provided at R.D. 24/3796 for the cart-track that leads to Pappapatti. A sluice for the direct irrigation of 221 acres will be provided at R.D. 24/5130, and an irrigation syphon at R.D. 24/5630 to pass the Pappapatti tank water to its ayacut. Immediately after passing through the saddle, the surplus channel from Pappapatti tank will be crossed at R.D. 24/6430 where a syphon aqueduct with 2 vents 6′ × 4′ is provided.

R.D. 24/8630 to R.D. 26/3630.

A foot bridge is proposed at R.D. 24/9530 for the path leading from Peyyadipatti to Ganderviduthi, and the Odappaviduthi channel for 1,279 acres will take off at R.D. 25/0830. An irrigation culvert will be provided at R.D. 25/2630 to pass water under the canal from the Konichi tank to the wet lands under it. The surplus from Konichikulam will be crossed at R.D. 25/3560 where a syphon aqueduct with 4 vents of 6′ × 5′ is proposed.

A "C" class bridge will be provided at R.D. 25/6130. A sluice for direct irrigation is provided at R.D. 25/6200 for 351 acres. The drainage course at R.D. 25/9530 will be crossed by a syphon aqueduct with 2 vents of 6′ × 4′. The supply channel to Kodikarambai Eri will be crossed at R.D. 26/1730, where a tank supply sluice will be provided, and the upland drainage diverted to the drainage at R.D. 25/9530.

R.D. 26/3630 to R.D. 27/8603.

The canal will cross the roads to Pattukōttai and Karambakudi at R.D. 26/3630 and 26/4030, respectively, and one "B" class bridge will be provided at R.D. 26/3830 to serve for both the roads. The head of the Akkaravattam channel for 4,870 acres will be at R.D. 26/6428. A surplus sluice will be provided at R.D. 26/7428 with a capacity of 1,480 cusecs, and will discharge into the Pannikondanviduthi tank. The supply channel to this tank will be crossed at R.D. 26/8428 by a syphon aqueduct of 8 vents of 6′ × 5′; and as the F.T.L. of the tank is higher than the crest of the lift wall of the syphon, a tail channel will be cut along the foreshore of the tank, above F.T.L., and connected with the surplus channel of the tank below the weir where there is a good fall in rear. Below this crossing the

canal will be taken by cutting through a small ridge into the bed of Neikulam and Mavukulam which will be absorbed, and whose ayacuts supplied by the Alivalam channel which will take off at R.D. 26/9328. The upland drainage now entering the tanks will be diverted to the syphon aqueduct at R.D. 26/8428. A regulator is proposed at R.D. 26/9428, and the full supply depth in the canal below this regulator will be reduced to 5½ feet. A sluice for the direct irrigation of 315 acres is proposed at R.D. 27/9428.

The channel that supplies Nochikulam will be crossed at R.D. 28/2135 by a

R.D. 27/8403 to R.D. 29/3603.

syphon aqueduct with 4 spans of 6 × 4 feet.

Two small drainages will be crossed at R.D. 28/4885 and 28/6095 and these will be diverted to the one at R.D. 28/2135. A "C" class bridge will be provided at R.D. 28/5135. The Kayavur channel will take off at R.D. 28/6135 for 6,576 acres. An irrigation under-tunnel will be provided at R.D. 29/0135 for passing tank water to wet lands below. A syphon aqueduct with 2 vents of 6 feet is provided at R.D. 28/9500 to pass the surplus of the tank above. Passing this drainage the canal will cross the spur near Karambakkudi in cutting, the maximum depth of which is 8·54 ft. The Pannavayal channel will take off at R.D. 29/2635 for 9,386 acres. A "C" class bridge will be provided at R.D. 29/3635 for the cart-track from Karambakkudi to the adjacent villages.

A sluice for the direct irrigation of 180 acres will be provided at R.D. 29/9435

R.D. 29/3603 to R.D. 30/8603.

to irrigate the lands under the Kummarakulam. The canal will cross the supply channel to Kummarakulam at R.D. 30/2135, where an under-tunnel with 2 vents of 12′ × 4′ has been proposed.

The Nariyar is crossed at R.D. 30/2685 where a syphon aqueduct with 12 vents of 12′ × 10′ will be provided. This stream is only a spill from the Agniar and the total catchment of the two streams is 294 sq. miles. Cross-sections of the two streams at the Pudukotta road crossing show that the capacity of the Nariyar is one half that of the Agniar, and consequently the waterway required has been proportioned between the Nariyar and the Agniar in the ratio of 1 to 2. The canal will then run in rear of Karambakkudi tank, through the wet lands forming the tank ayacut, and irrigation syphons are proposed at R.D. 30/4435 and 30/5 35. A sluice for the direct irrigation of 150 acres is also proposed at R.D. 30/6180 to irrigate the lands under the Karambakkudikulam, when necessary. The canal will then cross the Agniar at R.D. 30/7835 where a syphon aqueduct with 24 vents of 12′ × 10′ is proposed. After crossing the Agniar, the canal will run below the tanks of Illakkaviduthi and above the Tirumananjeri tank, whose supply will thus be cut off. Irrigation syphons will be provided at R.D. 30/9935 and 31/2435 to pass water from the Adayakulam and Ponnappakulam tanks to their ayacuts, and a sluice for direct irrigation of 133 acres at R.D. 31/1435 to irrigate the same when necessary.

Below the Agniar crossing, the canal will run above the foreshore of Tiru-

R.D. 31/2675 to R.D. 37/2500.

mananjeri tank whose supply channel at R.D. 31/3900 will be diverted towards the Agniar, and a sluice to supply the tank will be provided at R.D. 31/6000. A "C" class bridge is proposed at R.D. 31/7325, and a sluice for direct irrigation for 270 acres at R.D. 32/0500. The canal will then run along the foreshore of the Pattattikadu tank whose supply channel will be cut off by the canal and diverted to the drainage at R.D. 32/6400, and a sluice to supply the tank will be provided at R.D. 32/1750. The channel at R.D. 32/6400 will be passed under the canal by a syphon aqueduct with eight vents of 12 feet. After crossing the above channel the canal will run below the long tank of Kelatteru and above a group of three tanks including Odaikulam; the supply channel of the latter will be cut off and diverted to the drainage lower down by cross-bunding the gap between the two tanks as shown in plan No. G. 26. In order that the water of the long tank may reach its ayacut, three irrigation syphons are proposed under the canal at R.D. 32/7500, R.D. 32/9250 and R.D. 33/0500. A sluice for supplying the lower tank of Kelatteru is proposed at R.D. 32/9000, and the Odaikulam will be supplied by a sluice at R.D. 33/2500.

Another irrigation syphon is proposed at R.D. 33/6000 for the ayacut under Kelatteru small tank. The Pudupatnam branch canal will take off at R.D. 33/6500 for irrigating 37,043 acres. Just below the head of the Pudupatnam branch a regulator combined with a "C" class bridge is proposed at R.D. 33/6600, and the depth of water in the canal below this regulator will be reduced to 5′–0.

The surplus channel from Kelatteru tank will be crossed at R.D. 33/8334 by means of a syphon aqueduct with four vents of six feet, and a sluice to supply Madukkuvayal tank will be provided at R.D. 33/9500. The canal will then cross a drainage course at R.D. 34/2400 where a syphon aqueduct with four vents of six feet has been proposed.

A sluice for the direct irrigation of 146 acres is proposed at R.D. 34/3250. The supply channel to Nadan Eri will be crossed at R.D. 34/6250 by a syphon aqueduct of two vents of four feet. Just below this syphon aqueduct a "C" class bridge will be provided at R.D. 34/6500 for the cart-track from Naduvasal Kelpadi to Pudukkottai No. 12 channel will take off at R.D. 34/9000 for irrigating 1,581 acres, and the supply vari to Pudukulam will be crossed at R.D. 35/3750 by a syphon aqueduct with six spans of six feet. The drainage at R.D. 35/5200 will be diverted to the one at R.D. 35/3750 as both channels flow into the same tank. A "C" class bridge is proposed at R.D. 35/6900 for an existing cart-track as there will be no bridges for about one mile above and below.

The Pattukkottai-Nagaram Road will be crossed and recrossed at R.D. 35/9500 and R.D. 36/2000, and no bridge is necessary as the road can be carried along the left bank of the canal without interruption. The Ananthavallipuram channel will take off at R.D. 35/9500 for irrigating 1,758 acres. The drainage at R.D. 36/0300 will be diverted to the one at R.D. 36/1570 where a syphon aqueduct with one vent of four feet will be provided. A little below this syphon aqueduct, a surplus sluice with a capacity of 564 cubic feet per second, which is the discharge capacity of the regulator below, will be provided at R.D. 36/2000. The Kalanivasal channel will take off at R.D. 36/2500 for irrigating 6,459 acres, and a regulator combined with bridge is proposed at R.D. 36/2550 and below this full canal depth is reduced to 4½ feet.

A small drainage channel is crossed at R.D. 36/3100, and as this supplies certain tanks it is considered advisable to provide a separate syphon aqueduct with 2 vents of 4 feet. A sluice for the direct irrigation of 335 acres is proposed at R.D. 36/8500. A syphon aqueduct with 4 vents of 4 feet will be provided at R.D. 37/0800. An irrigation syphon for the ayacut of Mangadu tank is proposed at R.D. 37/2000, and a sluice for the direct irrigation of 140 acres will be provided at R.D. 37/2500.

R.D. 37/2500 to R.D. 45/6500.

The surplus channel from Theddampatti tank at R.D. 37/4000 will be diverted to the vari at R.D. 37/0800. A sluice for direct irrigation is provided at R.D. 37/5000 to irrigate 300 acres. A "C" class bridge is proposed at R.D. 37/7000. The Ambuliar which drains 58 square miles will be crossed at R.D. 37/8300, by a syphon aqueduct with 13 vents of 12′ × 6′. The canal will then run below Nagaram tank and go round Nagaram ridge on a contour. An alternative short cut in cutting was investigated and given up as not desirable. A sluice for direct irrigation is provided at R.D. 38/3580 to irrigate 340 acres, and two irrigation syphons at R.D. 37/9500 and 38/1000 pass the Nagaram tank water under the canal to its ayacut.

The next cross-drainage of importance is at R.D. 38/7800 where a syphon aqueduct with three spans of 4′ × 6′ is proposed, and the minor drainage at R.D. 38/6050 will be diverted to this work. A "B" class bridge is proposed at R.D. 38/8000 for the road to Pattukkottai. The supply channel to Ayyankulam at R.D. 38/9750 will be diverted to the drainage at R.D. 38/7800, and a small drainage culvert for this diversion channel will be provided for the Pattukkottai road. A sluice for direct irrigation is proposed at R.D. 38/9000 to irrigate 360 acres. The Pinnavasal Vadapadi channel will take off at R.D. 39/4000 for 2,530 acres. The supply channel to Vembangudi-Periakulam will be crossed at R.D. 39/8300 by a syphon aqueduct with 2 vents of 4′ × 4′. A "C" class bridge is proposed at R.D. 39/7500, and a foot bridge at R.D. 40/2500 and an irrigation sluice at R.D. 40/3000. The drainage course at R.D. 40/6000 will be crossed by a syphon aqueduct with

5 vents of 4′ × 6′, and the Pinnavasal-Tenpadi channel will take off at R.D. 41/3500 for 7,364 acres. The canal will then run through the Periyakodikulam which will be abandoned and whose ayacut (150 acres) will be irrigated by a sluice proposed at R.D. 40/8250. The Villuniar will be crossed at R.D. 41/6000 where a syphon aqueduct with 6 vents of 12′ × 6′ is proposed. A "C" class bridge is proposed at R.D. 42/2000. The Perianur channel will take off at R.D. 42/1000 for 884 acres. The surplus channel from Periyakulam will be crossed at R.D. 42/1400 by a syphon aqueduct with 1 vent of 4′ × 5′. The surplus channel from Nambidangulam will be crossed at R.D. 42/5400 by a syphon aqueduct with 1 vent of 4′ × 5′ and the surplus from Perialur Periakulam at R.D. 42/6400 by a syphon aqueduct with 6 vents of 6′ × 6′. The Ayingudi channel will take off at R.D. 42/9000 for 2,100 acres. The supply channel to Mangadu-Periakulam will be crossed at R.D. 43/2000 by means of a syphon aqueduct with 2 vents of 4′ × 4′. Sluices for direct irrigation are provided at R.D. 43/0500 and 43/2500 to irrigate 120 and 190 acres, respectively. A "C" class bridge is proposed at R.D. 43/2750 for the cart-track from Mangadu to the railway station. Irrigation syphons are provided at 43/5000, 43/8500, and 44/1500, to pass water from the Maruthangudi tanks to their ayacuts. A sluice for the direct irrigation of 246 acres is provided at R.D. 43/6000.

The Maruthangudiar will be crossed at R.D. 44/2000 by a syphon aqueduct with seven vents of 12′ × 6′. A surplus sluice of 350 cusecs capacity is provided at R.D. 44/3000, just below the Maruthangudiar crossing, to empty canal when necessary. A sluice for the direct irrigation of 250 acres is proposed at R.D. 44/4500. A "B" class bridge will be provided at R.D. 44/5000 for the road from Pattukkottai to Arantangi. The Tanjore District Board Railway to Arantangi will be crossed at R.D. 44/5500, and the rail level at the crossing will be 9½ feet above proposed bed of canal. The depth of water in the canal will be only 4 feet and there will be enough head-way for the railway bridge required. Below the railway-crossing an irrigation syphon is proposed at R.D. 44/6000 for the ayacut of the Natumangalam Eri, and the upland drainage that will be intercepted by the canal will be diverted to the surplus channel of the Nagamangalam tank, which is situated below the point where the main canal branches off into distributary channels. The cross-drainage work required in this connection is not therefore dealt with here. At R.D. 45/6500, the canal will bifurcate into the Amminichattram and Tiruvappadi distributary channels for irrigating 15,000 and 9,500 acres, respectively.

149. *Branch canals—The Kalianodai branch canal.*—The biggest branch of the Grand Anicut canal will take off from the left of the bank at R.D. 15/9800 for irrigating 87,819 acres. The canal will run 6 feet deep at the head and the head sluice is designed to pass full supply into the branch with only half supply in the main canal. The slope of the canal bed required to produce a suitable velocity of flow is less than the natural slope of the country along the direction of the ridge. This necessitates the provision of falls of which numbers are provided. The two cart-tracks that are intercepted at R.D. 2390 and R.D. 5200 will be diverted along the canal bank towards the head sluice on Tanjore-Oratanad road at R.D. 5855 where a "B" class bridge combined with a 3 feet drop is provided.

No. 1 channel will take off at R.D. 6680 L.B. for irrigating 486 acres. A "C" class bridge combined with a 3 feet drop will be provided for the cart-track near the village of Neikulaniar Kotah. A small saddle is crossed in embankment at R.D. 1/1960 so that command may not be lost lower down. In order to avoid deep cutting in the following ridge, the canal will be taken on a contour on the left side from R.D. 1/2290 to R.D. 2/1860. At R.D. 1/6910 Melavannipattu channel for irrigating 1/8878 acres and No. 2 channel for irrigating 664 acres will take off on the left and right banks, respectively.

Below these off-takes at R.D. 1/6940, a regulator is proposed so that water may be held up when required in times of scarcity. Below this regulator the depth of water in the canal will be reduced to 5·50 feet, so that the vents of the regulator have been designed to pass the full supply discharge with a head of 6 inches.

The Tanjore-Pattukkottai road is crossed at R.D. 2/2800 a "B" class bridge is provided here. No. 3 channel for irrigating 613 acres and No. 4 channel for irrigating 1,570 acres will take off at R.D. 2/7140 on the left and right banks, respectively.

A "C" class bridge is provided for the cart-track near Ulunur village at R.D. 2/8730. The canal will run in embankment with bed out of soil for about a mile from R.D. 3/1760 to R.D. 3/7200 and as this length along and is a saddle no higher ground is available, the embankment involved has been retained without dropping the bed so that command may not be lost.

No. 5 channel for 493 acres and No. 6 channel for 307 acres will take off at R.D. 3/7370 on the right and left banks, respectively.

A "C" class bridge is proposed at R.D. 4/5870 for the cart-track near Tennamanadu village. No. 7 channel for 882 acres and No. 8 channel for 486 acres will take off at R.D. 4/6610 on the right and left banks, respectively.

A "C" class bridge is provided at R.D. 5/4728.

No. 9 channel will take off from the right bank at R.D. 5/5850 for irrigating 450 acres. No. 10 channel for 617 acres will take off from the right bank at R.D. 5/8820.

A 6-feet drop is proposed at R.D. 6/1130.

At R.D. 6/7730, the Vadakadu branch canal will take off on the right side for irrigating 32,936 acres and Thirumangalakota channel will take off on the left side for irrigation 4,963 acres. A little below the above two off-takes at R.D. 6·7760 a regulator combined with a 3-feet drop is proposed, and the depth of water in the canal below this regulator will be reduced to 4·0 feet.

A "B" class bridge is proposed at R.D. 7/1690 for the Tanjore-Pattukkottai road.

No. 11 channel will take off on the right side at R.D. 7/4960 for irrigating 318 acres.

Below R.D. 7/4960, the canal will run on contour down to R.D. 8/6050 on the left side of a high ridge. No. 12 channel for irrigating 320 acres will take off on the left bank at R.D. 8/4630.

A "C" class bridge will be provided at R.D. 8/5230. At R.D. 8/6050, No. 13 channel will take off on the right side for irrigating 391 acres. From R.D. 9/0990 the canal will again run on contour down to R.D. 9/4760, where it will bifurcate into two channels, viz., No. 14 channel for irrigating 795 acres and Kalianodai channel for 21,174 acres.

150. *The Vadakadu branch* will as above stated, take off at R.D. 6/7730 on the right side of Kalianodai branch. The sluice at the head of this branch is so designed as to admit of full supply being passed with only half supply in the Kalianodai branch. The bed of the Vadakadu branch will thus have to be one foot lower than the sill of the sluice or the bed of the Kalianodai branch.

No. 1 channel will take off on the right side at R D. 1160 for irrigating 372 acres.

The Ettipulikadu channel will take off in the right side at R.D. 1/0180 for irrigating 4,128 acres. A "B" class bridge with one foot drop combined will be provided at R.D. 1/0680 for the road from Tanjore to Pattukkottai. A "C" class bridge will be provided at R.D. 2/0300 and from R.D. 2/0680 to R.D. 2/9180 the canal will run on contour avoiding a high ridge. A "C" class bridge with one foot drop combined is proposed at R.D. 2/6780. No. 2 channel will take off on the left side at R.D. 2/9180 for irrigating 827 acres. The canal will again run on contour from R.D. 3/1680 to R.D. 3/8974. No. 3 channel for 274 acres will take off on the right side at R D. 3/1680 and No. 4 channel for 328 acres will take off on the left side at R.D. 3/4680. The Muthu Pattikudikadu channel for 1,208 acres will take off on the left side at R.D. 4/0474 and No. 5 channel for 695 acres will take off on the right side at R.D. 4/5974.

"C" class bridges are proposed at R.D. 4/3974 and R.D. 4/9974.

At R.D. 5/2474, a surplus sluice is proposed on the right bank for the purpose of cutting off the supply to the lower reach when necessary.

The Sendangadu channel will take off at R.D. 5/4974 for irrigating 1,820 acres. At R.D. 5/6200 which will be end of the branch canal, a "B" class bridge will be provided for the Pattukkottai-Mannargudi road. This bridge will be combined with a regulator and the combination of the canal below this regulator will be known as Vadakadu channel, a major distributary which will irrigate 21,423 acres.

151. *The Rajamadam branch canal* will take off at R.D. 19/2500 from the left side of the Grand Anicut canal, and as the fall just below is very rapid at head, the head sluice will be combined with a drop of 4 feet and another drop of 10 feet provided at R.D. 1320. Above this 10 feet drop No. 1 channel will take off at R.D. 1000 L.B. for 676 acres and No. 2 channel at R.D. 1000 R.B. for 326 acres.

Immediately below this drop a small depression is crossed and an under-tunnel is provided at R.D. 4000.

The canal will run on contour from R.D. 5225 to R.D. 9900. It will follow the ridge from R.D. 9900 to R.D. 3/1870, and again run on contour from R.D. 3/1870 to R.D. 3/4795.

The discharging capacity of the canal becomes less than 300 cusecs at R.D. 3/4795, and the continuation of the canal below this point is to be treated as a distributary by name "Rajamadam channel".

Except at the head, the fall of the country along the line of the canal is not very rapid. In addition to the 4 feet and 10 feet drops provided at the head, one 3-feet drop, two 4-feet drops and two 6-feet drops have been provided. The sluices for direct irrigation, the off-takes and the bridges proposed are all shown on the surveys and longitudinal sections.

The 6-feet drop at R.D. 3/4795 will be combined with a bridge and regulator, and in order to cut off the supply when necessary, a surplus sluice is proposed at R.D. 2/8620 R.B., a site from which water surplussed can be utilized in filling some tanks.

152. *The pudupatnam branch* will take off at R.D. 33/6500 of the Grand Anicut canal for irrigating 37,043 acres. The fall of the country at head is rapid (15 feet in 2,000 feet). The head sluice will be combined with a 3-feet drop and two 6-feet drops are proposed—one at R.D. 660 and the other at R.D. 1650.

From R.D. 2640 to R.D. 7180 a low saddle is crossed and beyond this saddle is situated the ridge on which Siruvaviduthi village stands. It is not proposed to carry the canal in high embankment for the purpose of commanding the ridge surrounding this village-site. The canal will therefore bifurcate at R.D. 7180 into Pudupatnam channel for 17,221 acres and Sethubavachattram channel for 18,752 acres.

153. *Special drianage works unnecessary.*—Throughout the area to be irrigated there is no necessity to dig drains or construct protective works. There exist good natural lines of drainage which will not be obstructed or interfered with by the proposed new works.

B.—Technical.

154. The plans furnished with the estimates for the Grand Anicut canal system are—

No.	
31	Sheets of survey and longitudinal section, main canal.
15	Do. of do. do. branch canals.
6	Do. of surveys or sections, alternative alignments.
17	Do. of cross sections of main canal.
128	Plans of masonry works, main canal.
25	Do. do. do. branch canals.

All the above are contained in port-folios Nos. 2 to 6.

155. *Velocity suitable to the system.*—The critical velocity adopted for design of the Grand Anicut canal system is 1·1 V_o (V_o is Kennedy's critical velocity for Punjab sand).

The data on which this was selected is given in Appendix V, Volume II, showing that in the heavy sand of the Cauvery, in rear of Cauvery and Vennar head regulators, a stable regime is established and that the velocities at normal supply

levels generally lie between 1·1 V_0 and 1·2 V_0. The arrangements for admitting only the surface water into the Grand Anicut canal will exclude the heavier rolled sand from that canal and it has been considered safe to adopt the lower value 1·1 V_0 for design purposes of this system.

(For the Vadavar system 1·15 V_0 has been adopted).

156. *Depth of canal.*—The F.S.L. at the head of the new canal is limited to that of existing Vennar so as not to raise the levels to which water must be held up for regulation purposes above the head regulator.

The depth of canal has been fixed as 7 feet at the head and this is gradually reduced as the canal becomes smaller. The maximum velocity carried in unprotected side slopes is 3·21 feet per second and it is considered unadvisable to exceed this.

In Tanjore town limits the canal depth is increased to 10 feet to reduce the width and so to limit the cost of construction, and it has been considered desirable to increased velocities to 1·2 V_0 to safeguard against the deposition of sand in this deep reach. In this length the side slopes are protected throughout.

157. *Fall of canal.*—The normal surface and bed falls given to the main canal to give the above velocities varies from—

0·15 per 1,000 near the head to
0·22 per 1,000 in the tail reach.

158. *Co-efficient of rugosity.*—The co-efficient of rugosity (N) in Kutter's formula on which calculations have been made is—

	N.
For canals bed width 50 feet and over	·020
Canals of bed width under 50 feet	·0225

159. *Standard side slopes.*—The standard side slopes worked to are—

For cuttings	1 to 1
For banks	$1\frac{1}{2}$ to 1

For purposes of discharge computations have been made as if the side slopes were $\frac{1}{2}$ to 1.

160. *Standards of banks and berms.*—The general standards adopted for banks, berms, etc., are shown in the following table :—

Table showing standard dimensions, etc., for main and branch canals.

Item.	Main canals and branches.		Remarks.
	5,000 to 1,000 cusecs.	1,000 to 300 cusecs.	
Width of berm of canal	$4+\frac{Q}{1,000}+\frac{d}{2}$, (d=depth of cutting and Q=discharge in cusecs).	$4+\frac{d}{2}$	....
Crest width of widest bank	23 feet with dowel or inner edge.	15	Dowel $1\frac{1}{2}$ feet top, 1 foot high and side slopes $1\frac{1}{2}$: 1.
Crest width of other bank	15 feet.	6 feet.	....
Free board	3 feet.	3 feet.	....
Depth of earth over hydraulic gradient 1 to 4.	4 feet.	3 feet.	....
Width of land to be acquired clear of banks when canal is in cutting deeper than balancing depth.	15 feet.	Half height of bank subject to a minimum of 5 feet.	The width to be computed to nearest whole foot.
Width of land to be acquired clear of banks when canal is in less than balancing depth of cutting.	15 feet in addition the full height of bank above ground.	5 feet and in addition the full height of bank above ground.	

161. *Full supply capacity of canals.*—The question of "Duties" is discussed in section II and the canals are designed to carry the water required at the lowest duty for the whole area to be irrigated with additional allowance for "Seepage." The duty fixed as the "lowest" is 73 acres per cusec at the head of distributaries or "direct offtakes" from main or branch canals.

162. *Allowance for seepage.*—The nature of soil through which the canals run varies but little and generally consists of "Sandy loam."

This soil is retentive of water 2 or 3 feet below the surface and becomes more and more retentive on sinking deeper. It is not, however, altogether impervious at ordinary depths. Seepage in this soil or in red loam has been allowed for at 3 cusecs per million square foot of wetted area.

In the Budalur cutting where the canal runs through gravel and disintegrated schist double this rate has been allowed.

From the head to R. D. 2/4000, no allowance for seepage has been made as the canal bed is approximately at dry weather sub-soil water level.

In the Tanjore town cutting also seepage at 3 cusecs per million square feet is allowed for.

163. *Surveys.*—The alignment of the main canals and distributary system is based on the following surveys :—

(*a*) Block maps 8″ to 1 mile.

These maps are compiled from the Revenue Survey village maps and on these are plotted at intervals of about ½ mile lines of levels termed "block levels" or "country levels".

With the aid of these levels, and the plotted lines of drainages, contours at 5 feet interval were interpolated on the block maps, showing the configuration of the country.

These maps reduced to 2″ to a mile are the contour maps accompanying the estimates. From these maps the general alignment of main canals and distribution system was laid out first on the maps and then on the ground

Resurvey and levelling on the ground of the lines so tentatively adopted followed, and realignment in such respect as seemed desirable carried out.

It is here to be recorded that in compiling the 8″ block maps and bringing together the block levels recorded on these, a great deal of patch work had to be done. Levels from surveys carried out at various times under several officers with different objects in view and referred to different bench marks have been made use of. Block levels from Mr. Moss original project and levels plotted in connection with the several trial alignments of canal have been incorporated into the maps. For the above reasons the accuracy of field levels cannot be vouched for, as if the map had been prepared from a single survey, done on a regular system throughout. Thus, while generally the block levels may be taken as materially correct, and the contours show correctly the main features of the country, they are not sufficiently accurate as to justify the laying out and design on these data of the "distributaries" not yet estimated for in detail.

In tracing the main canal endeavour to run at or near the balancing depth has been made, while the radius curves have been restricted to a minimum of 20 times bed width, or in default, the slopes at such curves have been protected with revetment.

When finally levelling the alignment of main canal, cross sections of considerable length have been taken at 500 feet interval, so as to allow minor alterations of alignment being made in office should such prove to be desirable.

Special site surveys of all cross drainages of any importance have been made and accompany the plans submitted.

Branch canals have been generally aligned on the crest of ridges without cross sectioning, but for short lengths where the ridge crest has been left these canals have been laid out on the same general lines as the main canal, with cross sections at 500 feet intervals.

List of Bench Marks left along alignments run will be found in Volume II.

The datum of levels is that of the G.T.S.

164. *Preliminary expenses (A).*—The preliminary expenses allowed in the estimate comprise the expenses incurred in these investigations and in preparing these estimates, together with those of Mr. Moss' previous investigations; of the above expenses, a sum of Rs. 55,000 is allotted as the share of the Grand Anicut System 'Main Canals and Branches'.

A further provision of Rs. 100 per mile for setting out and clearing the line of main canal and Rs. 60 per mile for branches is allowed in the estimate.

The sum of Rs. 31,000 for the immediate acquisition of land proposed to be occupied in Tanjore town by the canal works is also included under this head.

165. *Land (B)—Land widths and general cost of land.*—The width of land proposed to be acquired is in conformity with the widths of banks, berms, etc., given in the statement appended under paragraph 160. The general cost of the land to be acquired, as given by the Special Revenue Officer is as follows:—

	Per acre.
From head to Tanjore.	RS.
Dry land ...	80
Wet land ...	200
Below Tanjore.	
Dry land ...	50
Wet land ...	200

There is dry land irrigated under wells here and there below Tanjore and for this the Revenue Officer has given no rate.

For the purposes of the estimate, a rate of Rs. 200 per acre, the same rate as for wet land, has been allowed.

166. *Land acquired in Tanjore town.*—In order to prevent land speculation and resulting inflated values of the land to be acquired in Tanjore town east of the Fort Ditch, sanction has been given to acquire this at once and the estimated cost (Rs. 31,100) is included under 'Preliminary expenses' in this estimate and will, in the first instance, be met from Provincial funds—vide G.O. No. 308 I.A., dated 17th September 1910.

The details of the land to be acquired in Tanjore town are as follows:—

Above the entrance with the Fort Ditch the land has no special value and the usual provision for canal and spoil banks has been made. For the Fort Ditch portion no acquisition is proposed as the land required is Government land. In this portion no spoil bank is proposed to be formed and the spoil will be utilized in filling up the western ditch. In the whole portion through the Tanjore town no spoil banks are proposed, and all spoil in excess of what is required for forming roads on the canal banks will be removed by tram line or carts and deposited outside the town.

For this purpose it is proposed to acquire 23½ acres of dry land on the west side of the town and 30¾ acres on the south side.

Between the Vallam road and the Railway station road, i.e., from R.D. 13/4907 to R.D. 13/6778 it is not proposed to form roads on canal margins as the land available in the Muhammadan graveyard that intervenes is limited to a width of 80 feet only. Between the Vallam road and the Muhammadan graveyard, i.e., from R.D. 13/4907 to R.D. 13/6180, a width of 140 feet is proposed to be taken over—a part of it is already Government land, being the compound of the Collector's office and the taluk cutcherry. From R.D. 13/6180 to R.D. 13/6536, which is the Muhammadan graveyard, only a width of 80 feet is proposed to be acquired.

From R.D. 13/6530 to Railway station road at R.D. 13/6768 a width of about 132 feet is to be taken up. From Railway station road to Cadell's road and from Cadell's road to Negapatam road there will be roadway on both banks, and the width of land proposed to be taken up is generally 180 feet; from R.D. 13/7550 to R.D. 13/8900 an extra width of 35 feet is proposed to be taken up in order that the road on the left bank may be formed clear of an existing temple. Near Rangasamudram tank at R.D. 13/7300 an extra strip of land is to be taken up for forming a connecting road round the tank on the right side.

South of Negapatam road on account of the high bank on which the Railway line runs and the consequent difficulty of providing suitable road crossings, it is not proposed to form roadways on canal banks. Roadways on canal banks will be formed at and below the proposed regulator at R.D. 14/1640. Communication between the Railway crossing and this point exists by going along the Negapatam road and following a cart-track passing by an existing bridge under the railway and joining the canal again at the regulator.

South of the Railway crossing some houses have to be acquired, but these are no considerable value. The width of land proposed to be taken up from Negapatam road to Railway line is 180 feet, and south of the Railway line down to R.D. 14/1200 is 180 feet. The canal will gradually widen out from R.D. 14/1200 and consequently the width of land to be taken up will also gradually increase until at the proposed regulator it is 240 feet. Beyond the Municipal limit (R.D. 14/2096) the usual provision for land for the canal and banks has been made.

A detailed land plan for the Tanjore town land is recorded with the office copies of the plans of this project.

167. *Land acquired in the Muhammadan graveyard.*—Some difficulties were raised to acquisition of the land in Tanjore town in the portion passing through the Muhammadan graveyard. The Special Revenue Officer consulted the leading Muhammadan gentlemen of the town with a view to amicable settlement and came to an arrangement with them under which 80 feet width was to be taken up without opposition on the following conditions, to be given effect to when the canal works were being carried out:—

(1) Government shall acquire and present to the Muhammadan community of Tanjore for extension of the cemetery the adjoining piece of land lying between the present cemetery and the Prince of Wales Medical School known as the Imam Sahib Tekkal.

(2) Government shall construct at its expense a compound wall enclosing the existing burial ground and the land to be acquired under condition (1).

(3) Government shall construct at its expense in the compound wall an iron gate opening on the main road.

(4) Government shall construct at its expense a bridge over the channel wide enough for the free passage of corpses.

(5) Government shall construct as its expense a flight of steps of the existing mosque tank.

(6) There shall be no interference with or prohibition of burials in future in the rest of the burial-ground not acquired for the channel on the plea that the channel is passing through it.

(7) As considered necessary by the sanitary authorities to prevent pollution of the water, Government shall cement in a pukka fashion the sides of the channel when it passes through the burial ground.

(8) The mosque tank shall be maintained full of water while the channel is running full and that when the channel is annually closed the tank shall, if desired, be fully filled with water before closing the channel.

(9) The President, District Board, be addressed to exclude the two Muhammadan tombs at present in the Prince of Wales Medical School compound from that compound, and hand them over to the Muhammadan community with the site whereon they stand, and permission given to open a path to them from the main road.

The works referred to in conditions (2), (3), (4), (5) and (7) have been provided for under 'Works'.

Condition (6) has been agreed to by the sanitary authorities subject to the lining of the channel sides with cement or other suitable rendering. Condition (8) will be fulfilled as it is proposed to hold up water in the canal through Tanjore town during closure for bathing and washing. The acquisitions referred to in conditions (1) and (9) and the acquisition of the land for the canal through the cemetery are not likely to cost more than Rs. 500, and this amount is provided for under '(B) Land'.

168. *Regulators and sluices (D)—The head regulator.*—The head regulator of the Grand Anicut canal is provided with shutters of 30 feet span arranged to pass water either by raising or lowering the shutters so as to enable the surface water to be drawn on and thus silt excluded from the canal.

These shutters will run on free rollers.

Its cill is raised 3 feet above the canal bed and a water cushion is provided below the cill wall.

Full supply can be passed with a head of one-half foot.

169. *General type of regulator and sluices.*—The other regulators and sluices will be of the ordinary type with vents not more than 6 feet wide, regulated by screw-gearing shutters of the usual Madras type.

170. *Discharge capacities of sluices.*—All sluices with heads in main or branch canals are designed to be capable of passing full supply through the sluice from half supply level in the parent canal.

From distributaries, however, the sluices are designed to pass full supply only with full supply level in the parent channel. These sluices are, however, designed or a type facilitating economical enlargement of the vent should this become desirable.

Tank supply sluices are generally provided with only one vent. Sluices for 'direct irrigation' will be pipe sluices with masonry head and tail walls and with a vent stone in the head wall. For canals of over 1,000 cusec capacity pipe sluices are designed with cast-iron pipes. For smaller canals earthenware pipes are used.

171. *Regulators across canals.*—Regulators across canals are provided below points of off-take of branch canals and at places where there are changes in the depth of water. Such regulators are provided on the main canal below the heads of Kalianodai branch, Vadakadu branch, Rajmadam branch and Pudupatnam branch and also at R.D. 26/9428, 36/2550 and 41/3500.

On the Kalianodai branch a regulator is provided at R.D. 1/6940, and on the Rajamadam branch at R.D. 3/4785.

172. *Falls and weirs (E).*—The number of falls on branch canals are noted below :—

	Miles.	Number of falls.
Kalianodai	18	16
Vadakadu	11	7
Rajamadam	7	7
Pudupalam	$1\frac{1}{2}$	3

There are no falls or weirs on the main canal.

The types of falls and drops, with data of designs adopted for the project designs are given in detail under 'Distributaries, Vadavar system' (paragraph 245).

173. *Computation off run-off from cross drainage areas.*—For computing the necessary capacity of cross drainage works for the Grand Anicut canal the discharge given by a co-efficient of 600 with Ryves' formula has been adopted.

The statement of rainfall in Volume III gives details of the heaviest rainfall recorded in the rain-registering stations in the area to be drained or in similar and adjacent areas.

It will be seen that no fall of rain recorded has approached in intensity that of 23rd November 1893 and the resulting local floods are the highest on record.

On this occasion the maximum discharge of the Vennar below the head regulator with the shutters in the latter closed was 11,900 cusecs (Colonel Smart's report, appendix to G.O. Nos. 622 I., and 623 I., dated 18th June 1303).

The water constituting this discharge must have come from the catchment area of the 'Old Vennar' below the Old Vennar head.

This area is 83 square miles but the drainage works through which drainage from this area is passed into the Old Vennar have a capacity of only 6,000 cusecs.

The consequence was, that water was ponded up above the right bank of this river, which finally breached in several places, giving probably a greater discharge than that due to the natural run off. The discharge due to 83 square miles with co-efficient 600 is 11,418 cusecs. The maximum flood discharge recorded in the Vennar above Katchamangalam anicut with the head regulator closed was computed at 14,900 cusecs. If it is taken that the discharge 14,900 cusecs recorded is due to natural run off from the drainage of 83 square miles, the co-efficient to correspond would be 782. In addition to the discharge from the catchment of the old Vennar, there were breaches in the right bank of Vennar between the existing Vennar head and Katchamangalam anicut believed to have been made by ryots to drain their lands. This helped to swell the volume of water in the Vennar and it is probable that a free and open run off would not have exceeded 11,418 cusecs due to a co-efficient of 600.

Having in view how much greater the record of rainfall on the occasion was compared with any other recorded fall, and further that the fall *in each separate station in the catchment* was of record magnitude, and in every case the fall was on a surface already saturated, it is considered that this may be taken is the greatest provision which need be allowed for and 600 has been generally adopted a suitable co-efficient for all cross drainage works. At exception is made in the case of the aqueduct over the Agniar, the largest catchment intercepted (294 square miles) in which a run off is allowed for 5 inches in 24 hours (equivalent to a co-efficient of 895).

174. *Velocity through culvert.*—It has been considered prudent to design the cross drainage works for a maximum velocity in the culverts of 8 feet per second although a velocity of 10 feet, or even more, could be occasionally safely passed, and this gives a margin of safety beyond the discharge computed from the above co-efficient.

175. *Cross drainage works (F)—Types of cross drainages.*—The types for cross drainage works provide generally for passing the drainage under the canals. In one case only is the Grand Anicut canal syphoned under the drainage.

The general type of drainage channel in Tanjore is shallow, wide, and ill-defined with flat approaches.

176. *Objections to drainage syphons and how dealt with.*—In order to avoid carrying the canal in bank for long lengths the drainage is generally syphoned under the canal, the floor of the drainage culverts being below the natural bed of the stream.

The objection to such a type of work is the tendency to fill up with silt to the level of the stream bed below the work, and there is a risk where the crown of the culvert is below or almost level with this bed level, that almost all water-way in the culverts may be filled up with sand, etc. There is danger in such a case of a sudden flood heading up and breaching the canal or submerging the country above it before the flow through the syphon can clear for itself sufficient water-way.

To guard against this, on the recommendation of the Inspector-General of Irrigation, a standard rule of design has been adopted that the underside of the crown of the arch of the culvert must not be at a lower level than 3 feet above the bed of the stream at the outfall end of the work. In the works estimated for, this rule frequently necessitates cutting out the bed of streams below the works to suitable falls and widths to conform to it, and to carry off the computed maximum discharge through the work, and such excavations are, where necessary, provided for in the estimates for the syphon aqueducts. The estimates provide for masonry, built of table-moulded bricks in surki lime mortar, plastered with Portland cement, resting on lime surki concrete slab foundations.

177. *Data of design cross drainage works.*—The pressures allowed on brick in arches or piers have been limited to an average over the sectional area taking the weights of $2\frac{1}{2}$ tons per square foot, and the thickness of piers and arches are proportioned so as not to exceed this Banks and bank connections allow a hydraulic gradient of 1 in 5. The pressure tending the blow up the arch over the culverts is computed from the maximum water-level below the work *plus* the head required to overcome friction in the culverts. Velocity through the culverts is restricted to about 8 feet per second.

The calculations for the heading up above syphon culverts is computed by Dr. Unwin's formula with co-efficient of loss on entry of ·505 and neglecting all velocity of approach.

It not infrequently happens that the computed maximum water-level above a work calculated as above leaves too little depth over the crest of the drop wall (or the top of the inlet slope) to allow of the flow over this of the maximum computed flood.

In such a case the drop wall has been considered as a broad-crested weir, discharging without velocity of approach, and the depth over the drop wall required to discharge the maximum flood has been taken as the M.F.L. above the work when this is higher than due to other computed level, which is the depth in the cistern between the drop wall and entrance of the culverts.

178. *Types of cross drainage works.*—The general types of syphon aqueduct or culvert adopted may be classified under three heads—

Type I.—The culvert carries the drainage under the canal and its banks without any contraction or alteration of the cross section of the latter. This type is adopted for works of small capacity.

Type II.—The canal at full width and the earth banks is carried over the drainage culverts, but the outer slopes of the canal banks are cut off and retained by face walls, and the top width of banks limited to 15 feet. In both these types entry and exit of drainage water in the culverts is generally by slopes not steeper than one-fourth and culverts are of spans of 6 feet and under.

Generally these slopes are run under the banks, thus diminishing the total length of culvert required.

Type III.—The canal either with full bed-width, or with contracted bed, is carried over the culverts between masonry walls providing over them a foot-way on one side and a cart road on the other.

This type is in most cases restricted to a standard span of culvert of 12 feet with arches with 2 feet rise. The entry of drainage is by a drop wall, but exit is by a slope not steeper than 1 in 4. The type is economical in the case of drainages of such large discharge capacity that the total lineal floor width of culvert water-way exceeds 54 feet.

179. *Contraction of canal in aqueducts.*—It is recognized that contraction of the canal through an aqueduct should only be made where material difference of cost is realized.

In this project the following arbitrary rule for contraction has been adopted, viz.—

Contract in works where the drainage requires a water-way of not less than 5 spans of 12 feet (60 feet lineal width) and when the saving realized by contraction is not less than Rs. 6,000. Contraction, where given, to be such asto raise velocity to about 5 feet a second in the aqueduct.

The heading up of water-level above the aqueduct over the level of water in the canal below the work to give such a velocity is computed never to exceed $\frac{1}{8}$ foot, making liberal allowances for losses by eddies, etc., and this being so, no alteration in height of banks or grading of the canal is provided for on this account.

The general data of design for cross drainage works are dealt with at more length in a note No. 116-I/111, dated 12th April 1910, in which further detail regarding types adopted will be found.

180. *List of cross drainage works.*—The list of the cross drainage works with full details regarding water-way, discharges, areas intercepted will be found in Appendix I, Volume II. In Volume III will be found details of the heaviest recorded rainfall in the areas draining across the line of canal.

The drainage map (plan No. G. 42) shows the area provided for at each work.

181. *Bridges (G)*—*Types of bridges.*—The road bridges provided for are divided into three classes—

(*a*) *Special class for Tanjore town.*—These are each designed separately to suit the special conditions of each site.

(*b*) *Bridges B-class carrying existing District Board roads over canal.*—These are 14 or 16 feet between wheel guards, generally the former, and can carry two lines of cart traffic.

(They are capable of carrying B-class loads as specified in Chief Engineer, Public Works Department Circular No. 4473-C., dated 15th September 1908.)

(*c*) *C-class bridges.*—These are 10 feet wide between wheel guards and can carry only a single line of cart traffic.

They are provided for existing cart-tracks and elsewhere when cart bridges are considered necessary.

(They can carry C-class loads.)

It is recognized that road bridges over canals of the ordinary brick arch type are most economical both as regards first cost and upkeep where the foundations stand on good soil; brick bridges, however, are not so quickly erected as those in which the roadway is carried on rolled steel beams over brick piers, while the amount of bricklayers' labour is materially less.

As the amount of brick masonry to be built in connection with this project distribution system is great, it is considered prudent to provide for bridges of the latter class and economise in bricklayers' labour If no difficulty exists as regards this, the sums provided will more than cover the cost of brick arched bridges, which can be substituted for the type estimated for.

182. *Instructions for adoption of differing classes of bridges.*—The following 'instructions regarding types of bridges' with the two attached statements give details on which the types of bridges provided for have been designed.

The spans in all cases are limited to a maximum of 40 feet clear and the decking if Westwood's trough plates supported by rolled-steel beams of standard sections.

Where bridges are 10 feet wide, piers are provided 4 feet longer than necessary to carry the beams and where 14 feet wide, two feet longer to give facilities for widening the roadway at any future time.

183. *Instructions for design of bridge*—(i) *C-class bridges.*—Ten feet between wheel guards to be of one type throughout as below :—

To be carried on two rolled beams over the span at 8 feet centres. The flooring to be $10\frac{1}{2}$ feet long, Westwood's trough plates, 5 inches deep, $\frac{1}{4}$ inch thick, 2′ 8″ centres between sections, and 1′ 4″ between centres of toughing, this weighs 15·52 lb. per square foot.

This will be filled with concrete of Portland cement mortar 1 to 3 to 2 inches over the top of plate or a total average $4\frac{1}{2}$ inches concrete.

(ii) *B-class bridges.*—Generally 14 feet width between wheel guards and to be carried always on three rolled-steel beams spaced at 6 feet centre to centre.

Flooring to be trough plates $14\frac{1}{2}$ feet long and of same section and thickness as for the C-class bridges, viz., 15·52 lb. per square foot, filled with cement concrete to similar depth.

(iii) *B-class bridges.*—For 16 feet wide road bridges four main girders will be used and the flooring plates will be 4 inches deep, $\frac{1}{4}$ inch thick of 13 95 lb. per square foot. No other alteration need be made.

(iv) *For all bridges.*—For spans exceeding 30 feet the rolled beams will be cross-braced in two places with an angle iron frame $2\frac{1}{2}'' \times 2\frac{1}{2}'' \times \frac{3}{8}''$ dividing the span into three.

Statement showing the rolled steel girders and trough plates chosen for various spans of " C " class bridges.

Width of roadway = 10 feet between wheel guards.

Equivalent of maximum load including weight of flooring plates = 208 lb. per square foot.

There will be two girders, 8-ft. centres, and the trough plates will be section I, ½″ thick, weighing 15·52 lb. per square foot for all spans.

Span.	15 to 22 feet.	23 to 24 feet.	25 to 26 feet.	27 to 30 feet.	31 to 35 feet.	36 to 40 feet.
Rolled steel beam	15″ × 5″ × 42 lb.	14″ × 6″ × 57 lb.	16″ × 6″ × 62 lb.	18″ × 7″ × 75 lb.	20″ × 7½″ × 89 lb.	4″ × 7½″ × 100 lb.

Statement showing the rolled steel girders chosen for the various spans of " B " class bridges mentioned below.

Trough plates	" B " Class.	14 feet width of roadway between wheel guards.	Section I, ½″ thick, weighing 15·52 lb. per square foot.
	Do.	16 " " " "	Section K, ¼″ thick, weighing 13·95 lb. per square foot.
Number of girders ..	" B " Class.	14 feet, three girders.	6-ft. centres.
	Do.	16 feet, four girders.	5-ft. "

Spans.	15 to 21 feet.	21 to 23 feet.	24 to 25 feet.	26 to 29 feet.	30 to 33 feet.	34 to 37 feet.	37 to 40 feet.
14-ft. wide roadway. Three beams at 6-ft. centres.	Central. 15″ × 5″ × 42 lb. Sides. 15″ × 5″ × 42 lb.	Central. 14″ × 6″ × 57 lb. Sides. 15″ × 5″ × 42 lb.	Central. 16″ × 6″ × 62 lb. Sides. 16″ × 6″ × 62 lb.	Central. 18″ × 7″ × 75 lb. Sides. 16″ × 6″ × 62 lb.	Central. 20″ × 7½″ × 89 lb. Sides. 18″ × 7″ × 75 lb.	Central. 24″ × 7½″ × 100 lb. Sides. 20″ × 7½″ × 89 lb.	.... Sides. 24″ × 7½″ × 100 lb.

Spans.	15 to 22 feet.	23 to 26 feet.	27 to 31 feet.	32 to 35 feet.	36 to 40 feet.
16-ft. wide roadway. Four beams at 5-ft. centres.	Central. 15″ × 5″ × 42 lb. Sides. 15″ × 5″ × 42 lb.	Central. 16″ × 6″ × 62 lb. Sides. 15″ × 5″ × 42 lb.	Central. 18″ × 7″ × 75 lb. Sides. 16″ × 6″ × 62 lb.	Central. 20″ × 7½″ × 89 lb. Sides. 18″ × 7″ × 75 lb.	24″ × 7¾″ × 100 lb. Sides. 20″ × 7½″ × 89 lb.

NOTE.—Calculated for load (including weight of floor plates) of 208 lb. per square foot.

184. *Foot bridges.*—These are designed to carry an external distributed load of 80 lb. per square foot.

The type selected and estimated for consists of two rolled beams of span not exceeding 34 feet and spaced at 5 feet centre to centre carried on brick masonry piers.

The decking is carried on the lower flange of the beams and consists of bent corrugated iron sheets 18 gauge butted on to the girders on each side and filled over with six inches of gravel. The rolled beams are prevented from spreading by angle iron stays passing under the beams and connecting the standards carrying the hand rails.

The standards are spaced eight feet apart. Intermediate between these a tie of one inch square iron passing under the beams bent round their lower flanges adds additional stiffening.

After some years the corrugated sheets will rust through; it is then proposed to remove the gravel and lay 9″ brick jack arches over the corrugated iron and fill up level with lime concrete. This is an inexpensive work and will be a charge against "maintenance".

It would be cheaper to put in brick arches originally, but it is not proposed so as to save bricklayers' labour required for other works.

Generally spans for foot bridges will be 20 feet and over up to 34 feet.

The steel beams required are—

Span 20 to 27 feet 12″ × 5″ of 32 lb.
,, 28 to 34 feet 15″ × 5″ of 42 lb.

185. *Numbers of bridges.*—Details regarding the numbers of bridges provided for and then distribution on "canals" and "channels" will be found in Section XI, paragraph (288), under "Communications".

186. *Escapes* (*H*)—Except in the portion through Tanjore town, where three small drainages of an aggregate catchment basin of 0·54 square mile are absorbed by the canal, it is nowhere proposed to take drainage into the canal. For the Tanjore town portion two escapes each with one vent 5″ × 5″ have been proposed at R.D. 13/6850 and R.D. 14/0090 and these are capable of discharging about 350 cusecs each.

It is however considered advisable provide to some escapes in the shape of surplus sluices where convenient at intervals along the canal line and above the Regulators, so that, in cases of emergency such as breaches and leaks, water may be cut off at once. With this object escapes in the shape of the surplus sluices have been provided at R.D. 5/9750, R.D. 13/6850, 14/0090, 15/9050, 26/7428, 36/2000 and 44/2800 on the Main Canal, at R.D. 4/2474 on the Vadakadu branch, and at R.D. 2/8600 in the Rajamadam branch.

187. *Buildings* (*K*).—The length of the main line is 85 miles and the lengths of the branch lines aggregate to 38 miles.

Ten permanent inspection bungalows are provided for. In addition to the above, provision is made for 14 temporary inspection sheds, which will be required during execution. The permanent inspection bungalows will be located at the following places:—

1. Sholagampatti.
2. Budalur.
3. Vadukur.
4. Thiruvonam or Kavalepatti.
5. Karakakurichi.
6. Nagaram.
7. Ayyangudi.
8. Thelungan Kudikadu.
9. Madukur.
10. Peraurini.

The temporary sheds will be located at intermediate places and in the tracts served by distributaries.

Permanent quarters for staff are proposed as detailed below:—

Executive Engineer's quarters at Tanjore	1
Assistant Engineer's quarters at Tanjore	1
Assistant Engineer's quarters at Pattukkottai	1

The following permanent offices are also proposed :—

Office for the Executive Engineer and the Assistant Engineers at Tanjore	1
Assistant Engineer's office at Pattukkottai	1
Lascars' quarters at sites of Regulators, generally for four lascars ...	19
Store sheds at sites of lascars' sheds	19

In addition to the above, temporary quarters are provided for a Superintendent of Works at Tanjore, and for an Executive Engineer at Pattukkottai. Also temporary quarters for upper subordinates will be provided at sites of important works, and for this purpose provision has been made for 35 temporary sheds at a cost of Rs. 400 each.

188. *Earthwork (L).*—The nature of the soil to be cut through is generally red or yellow sandy loam with the exceptions noted below :—

In the upper portion from head to R.D. 4/8000 the soil is black loam. In the Budalur cutting from R.D. 6/6720 to 7/3547 the surface soil is gravel for 6 feet depth and the sub-soil below 6 feet is decayed hornblende schist, as shown in the longitudinal section. In the Alakkudi cutting from R.D. 8/9500 to R.D. 9/7500 the surface soil is black loam and the sub-soil indurated clay and moorum gravel. In the Ramanathapuram cutting from R.D. 12/1000 to R.D. 12/6200 the soil to be cut through is gravel mixed with laterite. In the approach to Tanjore town the surface soil is red clay and the sub-soil Vallam sandstone which is a soft laterite sandstone which can be excavated without blasting. In the portion through Tanjore town from R.D. 12/9569 to R.D. 13/6730 a good depth has to be cut through Vallam sandstone. In the Peyyadipatti cutting from R.D. 23/9130 to R.D. 24/5630 the soil to be cut through is red loam except at the left flank of Pappaputti tank where gravel is met with at 5½ feet below ground level.

Different data for the rates to be allowed have been prepared to suit the nature of soil, lead and lift and these rates have been entered in the estimates. As it is undesirable to form spoil banks in the limits of Tanjore town, it is proposed to carry excess spoil on a tramway or on carts outside the town. A portion of the spoil will also be carted to fill up low places here and there within the municipal limits. For the portion of the work to be done within the Tanjore town special rates are allowed is shown in the data sheet attached to the estimate computed from the lead required to dispose of the spoil. The initial rate in the town varies from Rs. 5 to Rs. 9 and the cost of leading goes up to Rs. 15 per unit.

189. *Plantations (M).*—Plantations are proposed for the purpose of providing avenues along canal banks which will mostly be used as roads. The provision made works out to about Rs. 300 per mile.

190. *Miscellaneous (O).*—Under the head (O) Miscellaneous provision is made for the following works :—

(1) *Fixing demarcation stones along the main and branch canals.*—These will be Revenue survey stones and will be fixed at all field boundaries where the land is acquired and the fields are subdivided. This work will as usual be done by the Revenue Department, the Public Works Department paying the cost.

(2) *Fixing R.D. stones along the main canal and branches.*—For the purpose of ready indentification of localities during inspection, R.D. stones are provided for at distances apart of 500 feet along canal banks.

These stones will be 2′ 6″ × 0′ 8″ × 0′ 5″ and will be fixed in earth.

(3) *Fixing bench mark stones along the main canal and branches.*—These stones will be 2′ 6″ × 0′ 8″ × 0′ 5″ and will be fixed at about 2,500′ intervals in a concrete block 2′ 0″ × 1′ 6″ × 1′ 6″. The top and one face will be neatly dressed. A seat for the levelling staff provided on the top, and the letters B M cut on them.

(4) *Tank supply sluices—Irrigation syphons and sluices for direct irrigations.*—Sluices at heads of distributary channels go under the main head "3. Distributaries"; sluices at heads of "water-courses" not maintained by Government are included under the main head "2. Main Canals and Branches", sub-head "O. Miscellaneous". Sluices to supply tanks whose sources of supply are cut off by the canals, and irrigation syphons and culverts for passing under the canals the

irrigation channels from the irrigation sources lying above the canals are also included under this sub-head.

191. *Maintenance (P).*—Under the head "(P) Maintenance" the charges likely to be incurred on maintenance during construction, i.e., from date of completion of any section to date of its being brought into operation, have to be provided for. A provision of Rs. 40,000 for the main canal and Rs. 10,000 for the branch canals has been made on this account.

192. *High banks.*—There are no very high banks in the whole length of canals.

The highest are on the approaches to larger drainage crossings as named below:—

Solingampatti Vari	R.D. 4/0784
Sittarakudi Vari	R.D. 8/6247
Muthalai Muthu Vari	R.D. 10/0049
Maharajasamudram	R.D. 23/3360
Agniar and Nariar	R.D. 30/2500 to 30/4500
Ambuliar	R.D. 37/8300
Villuniar	R.D. 41/6000

The banks are designed to have a hydraulic gradient of 1/4 with 3 to 4 feet of dry earth over this (vide type section, Plan No. G. 223).

193. *Deep cuttings.*—The only cuttings which call for special mention occur in the first 30 miles of the main canal.

They are—

Budalur Cutting, R.D. 6/6720 *to* 7/3547.—The maximum depth of cutting is 15′ at R.D. 7/1247, and the soil of the cutting is red earth or gravel for the top 6 feet and below this hornblende schist in various stages of decay. The trial pits to bed level of the canal were all taken out without blasting.

The Alakudi Cutting, R.D. 9/0000 *to* 9/7500—*Maximum depth of cutting* $11\frac{1}{4}$ *feet at R.D.* 9/2247.—The soil is black loam or clay for the top 4 feet and below either indurated clay or moorum gravel.

Ramanadhapuram Cutting, R.D. 12/2219 *to* 12/5800.—The cutting is desirable with a view to approach of the railway crossing R.D. 12/3450.

The maximum depth is $12\frac{1}{2}$ feet at R.D. 12/2779. The soil is hard gravel and laterite.

194. *Tanjore Town Cutting, R.D.* 12/8899 *to* 14/4355.—There is a special description of the Tanjore Town section of canal and this includes the cutting which is not here described.

There are no other cuttings which call for special description, but there are to be cuttings about 8′ depth from R.D. 23/9130 to 24/5630 and from R.D. 29/1135 to 29/6635.

195. *Description of Tanjore Town section of canal.*—The approach to Tanjore Town is in deep cutting and through the town the depth of cutting will in general be such as to keep the full supply level as far as possible within soil. As land in the town is valuable and it would not be economically feasible to carry the canal through the town at full normal width, it is proposed to increase the depth of water from 7 to 10 feet and the bed and surface fall from 0·15 per 1,000 to 0·205 per 1,000, in this section. Under this arrangement the bed-width of canal will be reduced from 172 feet to 84 feet, and this connotes considerable saving in excavation. The contraction from 172 feet to 84 feet is proposed to be made gradually in a length of 440 feet and the fall of 3 feet in bed will also be gradually effected in the same length. This contraction will commence at R.D. 12/8899 where the depth of cutting is 8 feet, that is, the ground level is 1 foot above F.S.L., and it will end at R.D. 12/9339. At this contraction the velocity will change from 3·21 feet per second to 4·4 feet per second. The head required to produce this increased velocity is $\frac{(4{\cdot}40)^2 - (3{\cdot}21)^2}{64} = \frac{9{\cdot}06}{64} = 0{\cdot}14$. The fall in bed will be made to correspond will be 3·14 making the bed level at R.D. 12/8899, 166·57, and that at R.D. 12/9339, 163·36.

The surface soil for varying depths is red loam and the sub-soil is Vallam sandstone. The levels at which Vallam sandstone is met with are shewn in the longitudinal section (Plans Nos. 9 and 10 G). The cutting in Vallam sandstone will be given a side slope of $\frac{1}{2}$ to 1 and that in red loam a slope of 1 to 1. As elsewhere for the purpose of working out hydraulic particulars only a slope of $\frac{1}{2}$ to 1 is counted upon. It is considered advisable as a precaution against silt deposition in this narrow and deep reach to increase the velocity to $1\cdot2\ V_0$. As a safeguard against erosion by flow of water which will run with a velocity of 4·4 feet per second, it is proposed to plaster the sandstone sideslopes with cement mortar (3 sand to 1 cement) and to revet the earth slopes with brick on end 9″ thick laid dry and plastered with cement mortar, up to 1 foot above F.S.L. with a weep-hole to every square yard.

Vallam sandstone is a soft lateritic sandstone which weathers to a hard surface on exposure but gets soft in the presence of water. It has stood vertical in 20 to 25 feet cutting in the Tanjore Fort ditch for many years.

Below subsoil water level it can be excavated with pick and mammooty and goes into sand when excavated in the water.

Below F.S.L. it is thus necessary to protect the surface from disintegration by water.

The stone is quite useless for building or revetment.

The canal cutting which will be 8 feet at R.D. 12/8399 and 10 feet at R.D. 12/9339 will gradually increase to 26·74 feet at R.D. 13/3199 and the canal will enter the Fort South ditch at R.D. 13/3199. Within this length at R.D. 13/1719 the Seppunayakan tank supply channel will be crossed on the skew and a super-passage is provided to carry the tank supply, the bed of the tank supply channel being more than 19 feet above the proposed bed of the canal. At this place, Vallam sandstone is met with at a depth of 4 feet below the bed of the tank supply channel, so that the canal will be in sandstone cutting for a height of 15·5 feet above bed. The piers and abutments of the super-passage will be founded on the sandstone bed with a seating 2′ 0″ deep, while the wings will be stepped up on the top of rock giving them also a seating 2′ 0″ deep below the rock surface. The water-way provided for the canal at this super-passage is three spans of 27 feet, and the discharge to be carried 3,905 cusecs. The velocity through the vents will be $\frac{3,905}{810} = 4\cdot82$ per second, while the normal velocity will be only 4·4 feet per second. The head required to increase the velocity from 4·4 to 4·82 f.s. is $\frac{(4\cdot82)^2-(4\cdot40)^2}{64} = 0\cdot06$ and this is provided for by dropping the bed at the super-passage from + 162·90 to + 162·84.

Entering the Fort ditch at R.D. 13/3199, the canal will run along the ditch for a length of nearly 1,500 feet. In this length the proposed bed of the canal will be 3 feet to 4 feet lower than the existing bed of the ditch, and in cutting the canal in this length, care must be taken to see that the excavation is made well away from the base of the bastions on the north side, as these are not provided with foundations of any depth. The canal alignment is so located as to leave at the bastions a berm clear of the face of the bastion wall of 6 feet at 1 foot above F.S.L., allowing $\frac{1}{2}$ to 1 slope for the cutting in rock and 1 to 1 slope for the filling in above, which filling will be revetted. All widening required is provided for on the south side as shewn in plan No. G. 220.

The canal will then cross the Vallam road at R.D. 13/4907 where the road level will be $31\frac{3}{4}$ feet above the proposed canal bed Rock is met with at a depth of $14\frac{1}{2}$ feet below road level and the foundations of the piers' abutments and wings of the bridge will be dealt with in the same way as for the super-passage for the Seppunayakam tank supply channel. The width of the roadway will be 45 feet and the bridge will be constructed with brick-arches and with three spans of 27 feet each, as there is enough headway available. The afflux at this bridge will be 0·06 as at the super-passage at R.D. 13/1719 and the bed will be dropped from 162·18 to 162·12.

Crossing the Vallam road the canal will run through the compound of the Taluk cutcherry and the Collector's office, where some minor buildings (out-houses) have to be pulled down and re-built away from the canal alignment. For this work a sum of Rs. 2,300 is provided for in the estimate.

Passing the Collector's office compound, the canal will enter the Muhammadan graveyard and run right across it for a length of 540 feet from R.D. 13/6190 to R.D. 13/6730. There was a strong opposition for this alignment from the Muhammadan community, and by special arrangement made by the Special Revenue officer with the leading Muhammadans of Tanjore a strip of land, 80 feet wide, is by consent to be taken up on certain conditions which are described in detail in dealing with land acquisition (*vide* paragraph 167).

The canal will here be partly in rock-cutting and partly in earth-cutting, and the width of land available is limited to 80 feet. As a retaining wall will have to be provided for the portion in earth, the canal can be made only 75·5 feet wide with vertical sides, as 2′ 3″ retaining wall is required on each side. With this width of 75·5 and vertical sides, a bed-fall of 0·315 per 1,000 is required for carrying 3,905 cusecs, and the velocity will be 5·17 per second. In order to generate this increased velocity a small afflux of 0·12 will be necessary, as shewn below:—

$$\frac{(5{\cdot}17)^2 - (4{\cdot}40)^2}{64} = \frac{26{\cdot}73 - 19{\cdot}36}{64} = \frac{7{\cdot}37}{64} = 0{\cdot}115 \text{ foot or say } 0{\cdot}12 \text{ foot.}$$

This afflux has been provided for by dropping the bed at entry from 161·85 to 161·73. The bed-level at exit will be 161·56 allowing a fall of 0·315 for 540 feet, and here the canal will resume the normal width of 84 feet and the normal velocity of 4·4 feet per second, and when this happens, the head lost at entry will also be regained though not to the full extent. Deducting $\frac{1}{3}$ for loss due to eddies and friction, it may be supposed that $\frac{2}{3}$ of the head lost will be regained, and on this supposition the bed-level at exit will be raised from 161·55 to 161·63.

The canal will then cross the railway station road at R.D. No. 13/6768 and as the headway available is not enough for providing a bridge with brick-arches a steel girder bridge with a roadway, 66 feet wide, is proposed. At the site of this work rock is met with at about $2\frac{1}{2}$ feet above bed, and the foundations of piers' abutments and wings will be dealt with in the same way as for the Vallam Road bridge. At this bridge the waterway proposed is two spans of 40 feet, and the velocity will be $\frac{3905}{800} = 4{\cdot}88$ per second. The normal velocity being 4·4 feet, the afflux required to increase the velocity from 4·4 to 4·88 is $\frac{(4{\cdot}88)^2 - (4{\cdot}4)^2}{64} = \frac{23{\cdot}81 - 19{\cdot}36}{64} = \frac{4{\cdot}45}{64} = 0{\cdot}07$.

The afflux is provided for by dropping the bed from 161·63 to 161·56. The roadway at this bridge will have to be raised $2\frac{1}{4}$ feet and approaches on a gradient of 1 in 50 are considered enough.

Just below the railway station road, a small drainage channel is met with, and this drainage will be absorbed by the canal and an inlet will be provided on the right bank at R.D. 13/6850. On the left bank at the same place, an escape in the shape of a surplus sluice with one vent, 5′ × 5′, is proposed as there is a leading channel in rear of the proposed sluice sufficiently low to make the escape effective. This channel eventually falls into the Samudra Eri.

The Rengasamudram tank at R.D. 13/7400 will be absorbed by the canal and the drainage that enters it will be taken into the canal, as it, at present, falls into the tank.

Below the railway station road the level of the subsoil rock gets lower so that it is only in a few places that Vallam sandstone is met with at or above the proposed bed level of the canal. In these places the side slopes of cutting will be made uniformly 1 to 1 as it is not considered desirable to retain a different slope for the small depth of sandstone met with in places.

The Resident's bungalow road at R.D. 13/8450 will be cut off by the canal and no bridge is proposed here as there will be roadway on both banks of the canal to form connection with Cadell's road. The canal will then pass through the southern portion of the compound of the Resident's bungalow and cross Cadell's road at R.D. 13/8890 where a steel girder bridge with 56 feet roadway will be provided. The level of the subsoil rock at the site of this bridge is 4 feet below bed and the foundations will consist of concrete 4 feet thick. The roadway will have to be raised 6·7 feet and approaches on a gradient of 1 in 50 have been proposed. The

water-way proposed for the canal is 2 spans of 40 feet as in the case of the railway-station road bridge, and the same afflux of 0·07 has been provided for by dropping the bed at this bridge from + 161·13 to + 161·06.

Passing Cadell's road, the canal will run through the compound of the Jubilee bungalow, very close to the main building, and as there will be very little compound left, the whole bungalow and compound will have to be acquired. The canal will then pass behind the compound of the Executive Engineer's bungalow cutting off a small portion of the same and cross the Negapatam road at R.D. 14/0150 where a steel girder bridge with 36 feet road-way is proposed. The road-level here will be 6·25 feet higher than the existing road-level and suitable approaches on a gradient of 1 in 50 will be provided as in the case of Cadell's road. The sub-soil rock-level is 3·8 feet below bed and the foundations will consist of concrete, 4 feet thick. The water-way provided is the same as that for Cadell's road, and the same afflux of 0·07 is provided for by dropping the bed from + 160·81 to + 160·74.

The small drainage channel at R.D. 13/9500 will be diverted towards the one at the Negapatam road crossing and inlet provided at R.D. 14/0090 right bank above the Negapatam road bridge. On the left bank at the same place there is a drainage channel sufficiently low to serve as an escape and a second surplus sluice with one vent, 5′ × 5′, is proposed here. Any water passing through the sluice will pass through the above-mentioned channel and fall into Samudram Eri. This is an irrigation work of considerable size. This surplus sluice as well as one at R.D. 13/6850 will also be useful for the disposal of the polluted water that may be left in the canal at the end of the closure, as during closure water will be held up in the channel for bathing and washing purposes. This water cannot be drained down the canal, as the bed will be raised 3 feet immediately the canal runs out of the town limits.

The South Indian Railway will be crossed at R.D. 14/0740 on the skew, and the design and estimate for the railway bridge provided for is supplied by the Railway authorities. As at sites of the other bridges the usual provision for the afflux required is made by dropping the bed from + 160·61 to + 160·54.

Below the crossing of the railway a cart-track will be crossed by the canal at R.D. 14/1640 where a combined bridge and regulator is proposed for the purpose at holding up water in the town portion of the canal during closure. The depth of water in the canal will be gradually reduced from 10 feet to 7 feet by raising the bed and the width gradually increased from 84 feet to 171 feet in a length of 440 feet as in the case of the contraction at the head of the town cutting. The regulator is proposed to be located just below where the bed has been raised and the canal widened out, so that the height of masonry and the height of the shutters may be reduced to the minimum possible. In this length, as the velocity becomes gradually reduced by the gradual enlarging of the wetted cross-section area part of the head lost at entry will be regained, and assuming this to be two-thirds of that lost in entry, the bed will rise 3·09, i.e., from + 160·40 to 163·49. The bed level of the canal below the regulator will be + 163·06 and as the depth of water in front and rear will be 7 feet, the head available is 0·43. The velocity of approach being 3·21 feet per second, the total head including that due to the velocity of approach is $0{\cdot}43 + \frac{(3{\cdot}21)^2}{64} = 0{\cdot}43 + 0{\cdot}16 = 0{\cdot}59$ feet. The water-way required to discharge 3,905 cusecs is about 800 square feet and 19 vents, each 6′ × 7′, give 798 square feet. Provision has however been made for 20 vents, each 6′ × 7′.

Care will have to be taken that this regulator is worked so as to keep a flow at the designed velocity ($1{\cdot}2\ V_o$) through the deep contracted reaches in Tanjore. If water is allowed to be held up at the regulator for the convenience of the bathers or others in Tanjore, the result will be the deposition of silt.

196. *Alternative arrangement of the Tanjore regulator.*—Before actual construction, as an alternative to the designed arrangement which involves a loss of head at the regulator of 0·43 foot, it may be considered whether a large span regulator should not be built here in combination with a " C " class bridge and the water held up by a system of rolled beams and needles.

The beams would be lowered once yearly at the end of the irrigation season into grooves built to take them in the piers of the bridge and the needles placed in position by hand.

Such a system would be slightly more troublesome to work than the finished regulator provided for, but would save the loss of head and any possible mismanagement of regulation during the flow season.

The alternative would further have the advantage of giving an additional 0·43 foot of head to force water through the canal syphon at R.D. 15/8750 with resulting reduction in cost of this work and greater security against deposition of silt in the culverts.

197. *Alternative alignments of canal through the Vallam ridge at Tanjore.*—The Alignment of canal through Tanjore involves heavy expenditure and several alternatives were considered as below.

Deep cutting through Vallam ridge south of the railway.—Plans and section showing this proposal (plan No. G. 36) may be referred to.

The deviation leaves the proposed line at R.D. 11/9719 and rejoins it at R.D. 14/4355.

The deviation line first passes through Ramanadapuram ridge in a cutting through clay 7′ deep and below Vallam sand-stone about one mile in length of maximum depth, 29 feet.

Between Ramanadapuram and Vallam ridge there is a basin in which black clay is deposited and the canal alignment runs through this altogether in clay for a mile, the depth of cutting being 15 feet.

From here the canal enters the main ridge composed throughout into a deep cutting which attains a maximum depth of 44 feet.

An estimate for this deviation gives a total Rs. 10,05,874 as against the cost Rs. 8,95,874 of the alignment selected.

The estimate however provides for lifting from the cutting to spoil banks on either side at ordinary rates amounting to Rs. 12–8–0 per unit including excavation of sand stone and it is believed that the risk of exceeding this is considerably greater than the risks of extra cost in the alignment selected through Tanjore town. On the figures given the line selected is the better and it is believed that these figures represent the probability in a more favourable light to the alternative than to the selected line.

The line chosen apart from cost has much to recommend it from the convenience and improvement to the town which the construction of this canal through it entails.

An alternative alignment north of the railway and of the selected line for approaching the Tanjore Fort was laid out.

This is shown in dotted lines on plan No. 12.

This line passes north of Seppunayakan tank and avoids the deep cutting on the approach to the Fort ditch. On this the canal enters the ditch at the north-west angle with a sharp curve changing direction one quarter of a circle.

The canal then runs in the ditch along the west as well as the south arms involving a second and very sharp right turn at the south-west corner of the ditch.

Although the earthwork in this alignment involves considerable saving in quantity, the alternative is open to great objection owing to the tortuous alignment and as the cost of the line adopted is by no means prohibitive, the straight alignment has been adopted.

198. *Alternative alignment at Budalur.*—An alternative alignment to the Budalur cutting R.D. 6/6720 to 7/3547 (*vide* plan G. 35) has been roughly estimated involving crossing to the north side of the railway and back again. The estimate works out to a saving in earthwork of about Rs. 50,000, but the cost of two railway bridges and of raising the rail level in this length would certainly be more than double this figure.

Alternative alignment between Tiruvonam and Karambakudi.—The line of main canal would be shortened by cutting through the saddle between Ambukovil and Pilaviduthi shown dotted on the 2″ contour plan. The maximum depth of cutting involved would be 17¼ feet. This alternative line gives smaller headway at the crossings of the Neriar and Agniar, while the estimated cost is greater by Rs. 9,545.

199. *Alternative of straight cut near Nagaram.*—This alignment is shown of the 2″ contour map dotted as an alternative to the line adopted R.D. 38/0000 to R.D. 40/6500.

The alternative involves a cutting of maximum depth 17⅓ feet and a total quantity of earthwork 6,686 units against 4,595 units in the line adopted.

The latter line has the advantage of saving the necessity of providing distributaries to carry the canal water to the point of the ridge which would be cut through were the alternative adopted.

200. *Alternative crossings of the Agniar.*—Surveys for an alignment crossing the Neriar and Agniar higher up were made (plan No. G. 38) and a line laid out along the foreshore of the bed of Karambakudi.

This line does not give sufficient headway at the river crossings and is considered inferior to that adopted.

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SECTION VII.

Main Canals and Branches—Vadavar System.

A.—General.

201. *Description of regulator and conditions of off-take at the Vennar-Vettar regulators.*—The Vennar is the southern of the two great irrigating rivers into which the Cauvery divides at the grand anicut.

Nineteen miles below the Vennar head regulator, the river sub-divides into two main branches—the Vennar, the right, and the Vettar, the left, and one minor branch "the Vadavar" to the right of the Vennar.

There are regulators screw-geared lift shutters across all these, the regulation of which is thus fully controlled.

The Vennar regulator is controlled by 30 lift shutters 10 feet span.

The Vettar is controlled by 17 similar shutters.

202. *The Vadavar and proposals for remodelling it.*—The Vadavar is the minor branch taking off from the right bank of the Vennar at the Vettar head. It is a contour channel and now irrigates 14,859 acres either by direct flow or through tanks.

It is proposed to remodel the Vadavar and extend it so as to irrigate an additional area of 43,091 acres. The existing head sluice is provided with four vents each 5′ × 5′ to meet the demands of the existing irrigation which is supplied by a system of turns. In order to meet the increased demand on account of the new irrigation a supplemental head sluice with eight vents each 5′ × 5′ is proposed to be constructed between the existing head sluice and the Vennar regulator and further supply will be on the "continuous flow" system. The ordinary F.S.L. in front of the Vennar-Vettar regulators is 5·0 feet and the F.S.L. in the Vadavar has been fixed at 4·5 feet so that a head of 0·5 foot is available for drawing full supply.

In addition to its irrigating duties the Vadavar has to perform an additional function as a drainage channel.

In times of very heavy floods in the Cauvery, the Vennar has to assist the parent river in carrying off a share of the flood waters, and this in turn has to be carried by the branches into which the Vennar divides, viz., the Vennar, the Vettar. As the highest floods in the Cauvery occur during the south-west monsoon when there is never very heavy local rainfall and when frequently the local rainfall is negligible it is considered desirable to make provision for passing into the Vadavar on such occasions a share of the flood to assist the other two branches. It has therefore been arranged to pass 2,000 cusecs down the Vadavar into the Vaduvur tank and into the Kannanar valley when the Vennar is in high floods and the absence of local rainfall permits, and this has been taken into account in designing the supplemental head sluice. Details of calculations regarding the waterway provided are given in Appendix IV of Volume II.

203. *Description of the existing Vadavar.*—The existing Vadavar is an old native work and is in general 50 feet wide, and as a mean fall of 1·82 feet per mile. There are a large number of off-takes from it for serving its present ayacut of which 3,308 acres lie below the Vaduvur tank into which the channel tails. The total length of the existing Vadavar from its head to the infall into the Vaduvur tank is a little over 21 miles. It is a contour channel and is for long stretches without any bank on its right side and thus receives upland drainage in times of local rainfall. When this has to be carried by the Vadavar, the water-level rises very high. In order to keep the water-level within limits a surplus weir known as "Maruvanapattu surplus" has been built at R.D. 2/3100 feet, and this surplus work is useful for disposing of the drainage entering the channel above it coming from an area of 11·37 square miles. Below this surplus work and above Tanjore town, the big drainage course known as the "Muthalaimuthu Vari", which drains 86·0 square miles, enters the Vadavar. This drainage water as well as the local drainage of Tanjore town from an area of 6·75 square miles is carried down the Vadavar to the Puliampallum surplus at R.D. 4/1910 feet.

Below Puliampallum surplus, there are no surplus works on the Vadavar and the balance of all drainage water not disposed of into the Vennar by the above two works has now to be carried by the Vadavar into the Vaduvur tank.

204 *Proposed remodelling of the Vadavar.*—For the newly proposed working conditions the existing bed-fall of the Vadavar is too great and, if left unaltered, the velocity would be excessive; it is therefore proposed to regrade the canal giving velocities suitable for the conditions of discharge as described later under heading "Technical."

The existing arrangements for the disposal of the upland drainage entering the Vadavar are not at all satisfactory. The Muthalaimuthu Vàri is a big stream liable to bring down a maximum flood discharge computed at 11,688 cusecs. This stream enters the Vadavar above Tanjore and the flood waters have to pass through the Tanjore town before they can be surplussed at Puliampallum surplus. The total quantity of water is much in excess of the safe-carrying capacity of the channel and floods occasion much damage to the town and often cause breaches in the left bank of the Vadavar. It is therefore now proposed to carry the Muthulaimuthu Vari by a super-passage over the Vadavar, at the site of the Maravanapattu surplus, where there is a surplus channel in rear, running into the Vennar. The Muthalaimuthu Vari itself will be led by a straight cut from near Kullimedu village to the proposed super-passage. The drainage entering the Vadavar above the proposed super-passage will be disposed off by two surplus sluices, the one at R.D. 5,280 feet and the other at R.D. 2/3,100 feet just above the super-passage. The drainage below the super-passage will be passed partly through the Puliampallum surplus into the Vennar and partly down the Vadavar into the Vaduvur tank. Details of the proposals regarding the disposal of the cross drainages are given separately under the heading "Technical."

205. *Divided allocation of cost of cross drainage works on the Vadavar.*—From the above it will be gathered that the existing cross drainage arrangements on the Vadavar are inadequate and unsatisfactory and such has proved to be the case.

The question of improving these has lately been under consideration but has been postponed on account of the proposals for extensions of irrigation involving this channel.

It will be clear that as material extensions of the cross drainage works are recognized as necessary even if this project is not carried out, the whole cost of the new cross drainage works should not be a charge against the project.

The matter has formed the subject of reference to the Superintending Engineer, V Circle, and that officer has accepted as a fair compromise the proposal that the cost of all the remodelling shall be borne by the project except those noted below of which half the cost shall be debited to the existing Cauvery Delta System and half to the Cauvery Reservoir Project, viz.—

All masonry surplus works.

The super-passage and straight-cut carrying the Muthalaimuthu Vari over the Vadavar.

(References—Superintending Enginneer, V Circle, No. 2189–I. of 15th June 1909 and Special Superintending Engineer, No. 179–I. of 8th may 1909.)

It has been assumed that the existing works will pay for extensien of the barrels of any existing irrigation sluices which may be necessary on account of strengthening the Vadavar left bank.

The proposal has met with the approval of the Chief Engineer for Irrigation and is given effect to in abstracting the cost of works in the "Vadavar System."

206. *Bridges.*—There are three existing road bridges over the Vadavar—two in Tanjore town for the two roads that lead to Tiravadi and one near Pundi. There are also two railway bridges one at R.D. 4/5,540 feet for the main line to Madras and the other at R.D.8/1,180 feet for the branch line Tanjore to Negapatam.

The water-way on the two bridges in Tanjore town is enough for the proposed new conditions of the Vadavar, and the same is the case with the two railway bridges. The Pundi bridge which has only three vents of 15 feet will be pulled down and rebuilt with two spans of 34 feet each.

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In addition to the above it is proposed to provide within the length of the existing channel five new "C" class bridges and two foot-bridges. With the improved supply, the Vadavar will in future only with difficulty be fordable, whereas at present it is worked on a system of turns and is easily fordable on non-turn days.

207. *Remodelled or new channels with heads in the existing Vadavar.*—The extension of irrgation referred to in paragraph 1 is proposed to be effected by excavating the following channels :—

The existing Puthur channel which takes off at R.D. 7/9,530 feet of the Vadavar will be improved and extended so as to serve an additional area of 4,980 acres.

A new channel designated "Chetti Chattram Channel" will be dug taking off from the existing Vadavar at R.D. 9/1,410 feet for serving 1,810 acres.

The existing Ilupadi channel which takes off at R.D. 10/2,080 feet will be improved and extended so as to irrigate an additional area of 1,950 acres.

From half a mile above the infall of the Vadavar into the Vaduvur tank the Vadavar Extension Canal will branch off for the irrigation of 34,351 acres.

208. *Surplus regulator near the head of Vadavar extension.*—The Vadavar, as already stated, carries drainage water also and falls into the Vaduvur tank. Under the proposals for regrading the Vadavar, the proposed bed of the Vadavar, half a mile above its infall into the Vaduvur tank, will be 2·55 feet above the existing bed. A combined surplus sluice and drop is provided across the existing channel at a point 60 feet below the head of wadavar extension.

This work will serve the purpose of passing surplus water into the Vaduvur tank and also will supply water to the 3,308 acres that are now irrigated by the Vadavar below the Vaduvur tank.

The work consists of seven vents 5 feet span fitted with automatic swing shutters and one vent fitted with a screw-geared lift shutter through which supply for direct irrigation can be regulated when required.

209. *Description of the Vadavar extension canal.*—At the point of off-take of the Vadavar extension, a head regulator is provided R.D. 10/8300.

The Vadavar extension is an off-take from the left of the Vadavar, but both the Vadavar and the Vadavar extension have been treated as one canal, viz., the Main Canal, Vadavar System.

The Vadavar extension will run generally along the ridge on the left side of the Kannanar Valley, it follows the course of the existing Mannargudi Municipal channel from R.D. 11/4,840 feet to R.D. 12/1,770 seet.

The Muvanallur channel will take off at R.D. 11/4,015 for irrigating 2,680 acres and below this off-take a Drop 4 feet will be provided at R.D. 11/4,180 feet.

The Mannargudi channel will take off at R.D. 12/6,150 feet for irrigating 6,151 acres.

Below the off-take of Mannargudi channel between R.D. 12/8,700 feet and R.D. 13/7,940 feet the canal will run entirely in embankment as it crosses a saddle and no higher ground is available. The maximum height of the banks in this length is nearly 16 feet at site of two *channel crossings* and about 11 feet above the general ground level, the bed of the canal being generally about 4 feet above ground level. It has not been considered advisable to drop the bed on account of the loss of command involved in the lower reaches.

At R.D. 14/6,520 feet which, is the end of the Main Canal, Vadavar System, the Vadavar extension bifurcates into two channels, viz., "Vadavar No. 1 Channel" for irrigating 3,310 acres and the "Vadavar Extension *Channel*" for irrigating 20,960 acres. The Vadavar extension *channel* which is a continuation of the "Vadavar Extension *Canal*," is treated as a distributary and will be described under the head "Distributaries."

210. *Crops grown, communications and drainage of irrigated area.*—Regarding crops now grown, communications and drainage, etc., the remarks made in paragraphs 153, 288 and 219 apply to the Vadavar as well as to the Grand Anicut System.

B.—Technical.

211. *Detail of plans furnished.*—The plans connected with the Vadavar main canals and branches consist of a drainage map—10 sheets of survey and sections of the Vadavar and Vadavar extension, 50 sheets of cross sections of the Vadavar, 6 sheets of cross sections of the Mannargudi Municipal channel, 1 sheet of type cross sections, 4 sheets of site surveys, 16 sheets of plans of masonry work and 3 sheets connected with the diversion of the Muthalai Muthu Vari. These are all contained in portfolios Nos. 7 and 8.

The general standards of design are the same as for the Grand Anicut canal system described in paragraphs 158 to 162 with this exception, that, so far as the existing Vadavar is concerned, it is not proposed to form any bank on the right side as the upland drainage has to enter the Vadavar. The left bank is made 15 feet wide and 3 feet above M.F.L.

212. *Surveys and preliminary expenses* (*A*).—The proposed improvements to the Vadavar are based on the longitudinal section and cross sections of the existing Vadavar. The alignment of the Vadavar extension is based on country levels taken and posted on village maps (8 inches to 1 mile) as in the case of the branches of the Grand Anicut canal. With the aid of these levels and the village maps the alignment was pegged out on the ground and levelled over, and on these levels the designs are based.

The list of bench marks along the Vadavar and Vadavar extension will be found in volume II.

A sum of Rs. 20,000 has been provided for share of cost of preliminary surveys and this is intended to cover the cost of the preliminary investigation and preparation of estimates including the expenditure incurred on Mr. Moss's project.

For setting out canal alignments during execution, a provision of Rs. 60 per mile is made for the Vadavar extension canal. No such provision is necessary for the Vadavar as it is an existing canal.

213. *Land* (*B*).—The widths of land required for the Vadavar are shown in the cross sections (portfolio No. 8, plans Nos. V-42 to V-91). The width of land required for the Vadavar extension has been worked out as per details contained in the statement appended to paragraph 160, Grand Anicut canal. The rates allowed for land compensation are the same as for distributaries and are given in paragraph 243.

214. *Alignment and grading.*—The existing Vadavar will be remodelled by widening and improving it down to the point of off-take of the Vadavar extension, and the Vadavar extension will follow the ridge on the left side of the Kannanar valley.

The depth of water proposed for irrigation requirements is generally 4·50 in the Vadavar and 4·00 in the Vadavar extension. The depth of water below the Muthalai Muthu Vari syphon tunnel will be increased to 5·00 feet in order to avoid any appreciable widening in the portion through the Tanjore town and below Tanjore town the depth will again be only 4·50 feet. This reduction in depth is proposed to be effected not by raising the bed but by lowering the water level. No special regulator is proposed for this purpose, as the restricted waterway at the two bridges in Tanjore town necessitates the provision of head for afflux and the two bridges as they are tend to reduce the depth of water step by step from 5·0 feet to 4·5 feet as shown in the calculations embodied in appendix IV to volume II.

The depth of water will thus be 5·0 feet between Muthalai Muthu Vari syphon tunnel and bridge at R.D. 3/1350 feet, 4·70 between bridge at R.D. 3/1350 feet and bridge at R.D. 3/2910 feet and 4·50 below the bridge at R.D 3/2910 feet.

The bed and surface fall of the Vadavar as remodelled is to be 0·18 foot per 1,000 down to R.D. 8/1840.

From R.D. 8/1840 to R.D. 9/1410 feet the fall given is 0·19 per 1,000.

From R.D. 9/1410 feet to R.D. 10/8240, the point of off-take of Vadavar extension, it is 0·24 per 1,000.

The Vadavar extension will run only 4·00 feet deep, and for this depth the velocity required is 2·33 to 2·37.

The fall from R.D. 10/8240 feet to R.D. 12/6150 feet is proposed to be 0·24 per 1,000 and from R.D. 12/6150 feet to R.D. 14/6520 feet, it will be 0·25 per 1,000.

215. *Critical velocity, Vadavar system.*—The critical velocity for which the Vadavar sytem is designed is 1·15 V_o and the velocities computed vary between 1·14 V_o and 1·16 V_o.

The note on critical velocities (volume II appendix V) shows that on the data available the non-silting velocity for heavy sand of Cauvery is probably about 1·15 V_o. As the Vadavar is an existing work with an existing fall greater than that now proposed, and without special facilities for excluding silt at the head regulator, it is considered prudent to design for the above velocities in this system although for the Grand Anicut canal it has been decided to adopt the lower velocities 1·1 V_o.

216. *Cross drianage works (F)—Disposal of cross drainage—Existing conditions.*—The Vadavar is a contour channel and receives local drainage along its whole length. The drainage map plan No. V-29 shows the area that drains into the Vadavar in the different reaches. The old Vadavar which drains 4·875 square miles enters the Vadavar just below its head sluice, and between the first and fourth miles 6·50 square miles drain into the Vadavar. The Muthalai Muthu Vari which drains 86 square miles (mean flood discharge 11,688 cusecs) enters the Vadavar just above Tanjore town R.D. 2/8500 of the Vadavar. The Tanjore town drainage from an area of 6·75 square miles enters the Vadavar between the town and the Puliampallum surplus, and the surplus from the tank called Samudram eri which drains 8·0 square miles enters the Vadavar opposite Puliampallum surplus. Below Puliampallum surplus the total area that drains into the Vadavar in successive reaches amounts to 13·5 square miles and the drainage from this area is carried by the Vadavar into the Vadavar tank.

217. *Proposed arrangements for cross drainage disposal.*—From the sections of the Vadavar, it will be seen that the Muthalai Muthu Vari is too big a drainage to be absorbed by the Vadavar without occasional serious damage. It is therefore proposed to deal with this drainage separately by making a straight cut for this drainage from near Kullimedu village to the Maruvannapattu surplus as shown in plan No. V-18 and passing the Muthalai Muthu Vari over the Vadavar into the Vennar by means of a super-passage. The hydraulic particulars regarding the proposed straight cut and the super-passage are given in appendix IV, volume II. Having thus arranged to dispose of the Muthalai Muthu Vari without allowing it to enter the Vadavar, the other drainage arrangements will be now described.

It is proposed to deal with the drainage areas above and below the Muthalai Muthu Vari super-passage, as two separate blocks, so far as the maximum flood discharges are concerned, as these blocks are separated by the catchment basin of the Muthalai Muthu Vari.

The drainage that enters the Vadavar above the Muthalai Muthu Vari super-passage is proposed to be passed into the Vennar by means of two surplus sluices, one at R.D. 5,280 feet and the other at R.D. 2/3100 feet just above the proposed super-passage for the Muthalai Muthu Vari.

The Vadavar is proposed to be widened only to the extent required for carrying the quantity of water required for irrigation with a depth of 4·5 feet. Any excess water that the Vadavar has to carry either on account of the entry of cross drainages or on account of the letting in of a portion of the Vennar floods, is proposed to be carried by allowing the water level to rise to the extent required and raising the left bank sufficiently high to suit the M.W.L. thus arrived at.

In dealing with cross drainages entering the Vadavar, it has been assumed in conformity with the ordinary conditions that when the Vennar is in high floods, there is not much local drainage, and that when there is maximum drainage discharge on account of local rainfall, the Vennar is not in high floods. In order to relieve

the Vennar of the strain during high floods, it is proposed to carry 2,000 cusecs through the Vadavar, as at this period there will frequently be no local drainage entering the Vadavar.

The M.W.L. in the Vadavar will therefore be calculated with reference to either 2,000 cusecs or the drainage discharge, whichever is higher.

If, under extraordinary circumstances, there happens to be heavy local rainfall simultaneously with high floods in the Vennar, the latter must breach and the problem of flood water disposal left, as at present, to be solved by nature as the existing works are unable to cope with such conditions.

These are the general principles regarding the disposal of cross drainages, and the details of the proposals for each reach of the Vadavar will now be dealt with

The first surplus sluice is proposed to be located at R.D. 5,280 feet. The area that drains into the Vadavar above this surplus work is 4·875 square miles and the maximum flood discharge 1,722 cusecs with a co-efficient of 600 in Ryves' formula. As this is less than 2,000 cusecs, there is no necessity to pass the drainage into the Vennar so far as this drainage basin is concerned. Taking, however, the whole drainage basin above the proposed Muthalai Muthu Vari super-passage, which is 11·375 square miles, the maximum flood discharge works out to 3,060 cusecs, and as the Vadavar need not be made to carry more than 2,000 cusecs, the balance of 1,060 cusecs will be passed through surplus sluice No. 1.

The No. 2 surplus sluice is proposed to be located just above the proposed Muthalai Muthu Vari super-passage, and the drainage water that will be brought down by the Vadavar will be (3,060 — 1,060 =) 2,000 cusecs. The syphon for passing the Vadavar under the Muthalai Muthu Vari is provided with sufficient waterway to pass 2,000 cusecs when the Vennar has to be relieved at time of high floods. This quantity however cannot safely be passed through the syphon when there is local rainfall as the drainage water that is likely to enter the Vadavar below the syphon will itself be 2,142 cusecs. As much as possible of the 2,000 cusecs drainage will therefore have to be passed into the Vennar through the proposed No. 2 surplus sluice. The whole of the 2,000 cusecs could be passed into the Vennar if the syphon were combined with a regulator with shutters. This arrangement is not considered desirable as neglect of duty on the part of the conservancy establishment might lead to serious results.

So long as the syphon is not combined with a regulator, a certain quantity of drainage water will flow through the syphon tunnel so long as the water level in rear of the syphon is lower than the water level in front. The depth of water in the Vadavar in front of the syphon when the drainage discharge of 2,000 cusecs is carried is 6·7, and by opening the No. 2 surplus sluice, the water level may be kept lower though it is not possible to say exactly what conditions will prevail.

The depth of water in the Vadavar in rear of the syphon due to the maximum discharge of 2,142 cusecs from the drainage basin below is 8·1 feet. If it is supposed that a certain quantity — about 1,000 cusecs — is likely to pass through the syphon tunnel, this quantity will have to be added to the drainage discharge below the syphon, and the discharge to be carried by the Vadavar will amount to 3,142 cusecs. To carry this discharge, the Vadavar below the syphon will have to run 10 feet deep, and when this is the case, the front water level will only be 0·7 foot above rear water-level. This head of 0·7 foot for the waterway of 228·75 square feet is likely to give a discharge of 1,126 cusecs, which agrees fairly well with the 1,000 cusecs assumed above. If by opening the No. 2 surplus sluice, the water-level is kept about a foot lower, the discharge through the syphon tunnel will be considerably reduced. The conditions at the site of this work are rather peculiar and there may be occasions when the discharge through the syphon culverts will be very small.

On the other hand, there may be occasions when the discharge may be as high as 1,126 cusecs, and this will increase the M.W.L. below the syphon considerably. To be safe, it is arranged to design the No. 2 surplus sluice to pass the full 2,000 cusecs and at the same time to fix the M.W.L. in rear of the syphon on the supposition that 1,126 cusecs will be passed through the syphon tunnel into the reach below.

The existing Maruvannapattu surplus is proposed to be abandoned and demolished for the following reasons.

In the first place, a surplus weir is not suitable as when the Vadavar carries 2,000 cusecs of the Vennar floods no portion of the same can be passed into the Vennar without defeating the very object with which the 2,000 cusecs is let from the Vennar into the Vadavar.

Secondly, the location of the Muthalai Muthu Vari super-passage necessitates the demolition of the surplus work.

Hence the necessity for abandoning the existing surplus weir and proposing a surplus sluice just above the Muthalai Muthu Vari super-passage.

The drainage that enters the Vadavar above the Muthalai Muthu Vari super-passage will, as described above, be disposed of by the proposed surplus sluices Nos. 1 and 2.

Drainage below Muthalai Muthu Vari super-passage.—Taking the portion below the Muthalai Muthu Vari super-passage, the first drainage entering the Vadavar is the Tanjore town drainage. The drainage area is 6·75 square miles, and the maximum flood discharge 2,142 cusecs. Adding to this 1,126 cusecs the possible discharge through the Muthalai Muthu Vari syphon tunnel, the total discharge the Vadavar has to carry is 3,268 cusecs and will be carried with a water level 10 feet above bed. The left bank of the Vadavar will be raised to a minimum height of 13 feet above bed so that it may be 3 feet higher than M.W.L.

In this connexion it has to be considered whether the waterway at the two existing bridges in the Tanjore town would be enough for carrying the flood discharge of the Vadavar.

It is to be noted that no restriction or alteration of the existing waterways is proposed although the waters of the Muthalai Muthu Vari now passing down the Vadavar are to be kept out of it.

Taking the case of the bridge at R.D. 3/1350 the waterway provided is two spans of 25 feet with springing line 6 feet above canal bed and with a rise of 6 feet. Close to the bridge and on the right side of the canal there is a road dam 90 feet wide and to the right of the road dam there is also a drainage culvert with two spans of 25 feet.

With M.F.L. 10 feet above canal bed, the area of waterway available for the passage of flood waters is 975 square feet and the total flood discharge to be passed through is 3,268 cusecs. The afflux required excluding consideration of the velocity of approach works out to 0·28 foot.

Taking the case of the bridge at R.D. 3/2670, the waterway provided is two spans of 30 feet with springing line 6·28 feet above canal bed and with a rise of 6 feet. Close to the bridge and on the right side of the canal three is a drainage culvert with three spans, one of 10 feet and two of 9 feet.

With M.F.L. 10 feet above canal bed, the area of waterway available for the passage of flood waters is 700 square feet and the total flood discharge to be passed through is 3,268 cusecs. The afflux required excluding consideration of the velocity of approach works out to 0·53 foot.

From the above, it is considered that the waterway available for the passage of flood waters is enough at both the bridges and no further need be provided.

The next point where additional drainage enters is opposite Puliampallum surplus R.D. 4/1910 feet. The total area that drains into the Vadavar at and above the Puliampallum surplus is 14·75 square miles and the maximum flood discharge 3,609 cusecs. Adding to this the possible discharge through the Muthalai Muthu Vari syphon tunnel, viz., 1,126 cusecs, the total quantity to be provided for is 4,735 cusecs. As there is no regulator below the Puliampallum surplus, an allowance has to be made for the probable quantity of water that would be flowing down the Vadavar when the Puliampallum surplus is surplussing. This quantity cannot however be definitely ascertained, but in consideration of the powerful surplus sluices it has been counted that the flow past the sluices when fully open will not exceed 1,109 cusecs.

The balance of the drainage water that enters the Vadavar, viz. (4,735 — 1,109) or 3,626 cusecs has therefore to be disposed of at the Puliampallum surplus.

Puliampallum surplus sluices.—The existing Puliampallum surplus is provided with four vents each 6′ × 6′ with sill at 117·84 and in addition a weir 102 feet long with the crest at 123·67. There is also an old surplus weir forty feet long with crest at 24·58.

Under the proposed improvements to the Vadavar the bed of the Vadavar at the Puliampallum surplus will be 119·66, and the water-level to carry 2,000 cusecs will be 126·66.

The sill of the surplus sluices is therefore proposed to be raised to 129·66 and the crest of the surplus weirs to 126·66. The draw to the surplus sluices when fully open will so greatly affect surface level in the vicinity that it is considered unsafe to count on any effective aid from the solid weir with crest at 126·66; it is therefore proposed to compute for the disposal of the whole drainage discharge to be surplussed by means of surplus sluices, and count the remaining portions of the weirs only as a margin for safety.

The four vents of the existing surplus work with sill raised to the proposed bed-level of the Vadavar are capable of discharging 1,930 cusecs. The total discharge to be passed through being 3,626 the total number of vents 6′ × 6′ required for the purpose is 7·5 or say 8. It is therefore proposed to provide 4 additional vents in the existing surplus weir. The hydraulic particulars and calculations in connexion with the surplus sluices Nos. 1 and 2 and the improvements to the Puliampallum surplus (which is surplus sluice No. 3) are given in appendix IV, volume II.

The third point below Muthalai Muthu Vari super-passage, where additional drainage enters the Vadavar, is at R.D. 5/9730 feet. The total area that drains into the Vadavar above this point is 19·0 square miles and the maximum flood discharge 4,272 cusecs. Adding to the above the probable discharge through the Muthalai Muthu Vari syphon tunnel, viz., 1,126 cusecs, the total drainage entering the Vadavar is 5,398 cusecs of which 3,626 cusecs is passed through the Puliampallum surplus. The balance to be carried by the Vadavar is therefore 1,772 cusecs. This discharge being less than 2,000 cusecs, the M.W.L. has been worked out with reference to 2,000 cusecs and the left bank of the Vadavar proposed to be raised to a height of three feet above this M.W.L.

The fourth point below the Muthalai Muthu Vari super-passage where additional drainage enters the Vadavar is at R.D. 8/4810 feet. The total area that drains into the Vadavar above this point is 21·50 square miles and the maximum flood discharge 4,638 cusecs. Adding to the above the 1,126 cusecs likely to be passed through the Muthalai Muthu Vari syphon tunnel, and deducting the quantity proposed to be passed through the Puliampallum surplus, the balance to be passed through the Vadavar at this point is 4,638 + 1,126 — 3,626 = 2,138 cusecs, and water-level required for this discharge works out to a depth of 7·25 feet. The left bank of the Vadavar is proposed to be raised to suit the above maximum water-level.

The fifth point below the Muthalai Muthu Vari super-passage, where additional drainage enters the Vadavar is at R.D. 10/8240 feet. The total area that drains into the Vadavar above this point is 28·25 square miles and the maximum flood discharge 5,565 cusecs. Adding to the above the 1,126 cusecs likely to be passed through the Muthalai Muthu Vari syphon and deducting as before the quantity to be surplussed through Puliampallum sluices the balance to be carried on by the Vadavar is (5,565 + 1,126 — 3,626) = 3,065 cusecs.

This surplus discharge will be passed into the Vaduvur tank through the surplus regulator (No. 4 Surplus sluice) described in paragraph **208** *supra*.

The Vadavar extension runs mostly on a ridge and there is no cross drainage to speak of.

218. *Escapes* (*H*).—The surplus sluices proposed in connexion with the disposal of cross drainages, have all been described under "cross drainage works." There are no other escapes besides the surplus sluices.

219. *Buildings* (*K*).—It is proposed to provide three inspection bungalows—one at Satyamangalam, a second at Vaduvur and the third at Ullikota. No temporary inspection sheds or staff quarters are proposed, as necessary temporary sheds can be provided under the item "Shed for materials and workmen" in the estimates for important works.

Regulation of the new head regulator will be carried out by the existing establishment at the Vennar Vetter head and no provision of additional quarters here is made.

Quarters for working staff are proposed as follows:—

Permanent huts for two lascars will be provided at the site of surplus sluice No. 1 as lascars will have to be stationed at the site of the work during the rainy season (R.D. 5280).

Similarly huts for two lascars will be provided at the sites of surplus sluices at R.D. 2/3100 feet and at 4/1913 feet.

At R.D. 10/8300 feet where surplus sluice No. 4 and the Regulator at head of Vadavar extension have to be regulated provision is made for huts for four lascars.

At R.D. 14/6520 feet which is the tail end of Vadavar extension, huts for two lascars will be provided for looking after the regulation at heads of Vadavar No 1 channel and Vadavar Extension channel.

In addition to the above, a store shed will the required at R.D. 10/8300 feet and provision has been made for one of dimensions (internal) 18′ × 12′ at the above mentioned place.

220. *Remarks on other estimate sub-heads.*—The technical remarks and explanations given as regards the grand anicut canal system under other headings of work apply equally to this system and are not here repeated.

Building materials and rates are treated of in Section X.

SECTION VIII.

DISTRIBUTARIES—VADAVAR SYSTEM.

(The typical area.)

A.—General.

221. *System of mileage for distributary system.*—The system of recording reduced distances on the Vadavar "Distributaries" differs from that adopted for the "Main and Branch Canals."

In the distributary system reduced distances are stated in *statute miles* and feet from the head of the distributary channel.

A different system has been adopted, based on a decimal notation, for the "Main Canals and Branches" (including those on the Vadavar system) in deference to the wishes of the Inspector-General of Irrigation and this has been described in paragraph 142.

The same system has not been adopted, for the "distributaries," because nearly all the field work and much drawing had already been done on a statute mile basis, when these views were expressed, and also because the convenience of a notation based on a unit of 10,000 (or 5,000) feet is not so marked in the case of distributaries as in the case of long contour canals.

222. *System of nomenclature of canals and distributary channels.*—Main and branch canals are called "Canals" in contrast to "Channels" which is the term used for all "distributaries" which include every channel of less carrying capacity than 300 cusecs.

The field distribution channels to be constructed by or at the cost of the ryots or landholders are termed "Water courses." The channels of the distribution system to be constructed by Government receive either a name or a name and number under the following rules :—

Every channel will bear both a name and a number for only that part of it below the last point of bifurcation or off-take from it of some other Government channel. The name will be that of the channel or canal in which its head is situated.

The number will be fixed by the position of the head in consecutive order of such off-takes from the head of the parent channel.

Thus every channel distinguished by a number as well as a name has no other channel off-taking from it, but itself off-takes from the channel named.

Example—

Palayur No. 2 channel or
No. 2 channel Palayur block

would be the second such channel off-taking from the Palayur channel.

It follows that every Government channel from which any other Government channel off-takes is identified by a name *without any number* down to the lowest point at which any Government distributary takes off from it.

The name given, is generally, that of some village in which a material area is irrigated by the channel.

An exception made to the above rule is in the case of an existing channel (Iluppudi channel) already bearing a name. In this case the existing name is left unaltered.

223. *Description of the country served by the distributary system.*—The country served by the Vadavar distribution system consists of alternate ridges and valleys and the new off-takes from the Vadavar generally run on the ridges.

Many of the valleys are already irrigated with the aid of the Vadavar water partly direct and partly through tanks. The proposed off-takes are aligned along the minor ridges for the irrigation of the dry lands lying on both sides. The general fall along the lines of the ridges varies from 3 feet to 6 feet per mile, while the fall of the sides of the ridges varies from 15 feet to 40 feet per mile.

224. *General description of the distributary system.*—The Puthur channel, Chettichatram channel and the Iluppudi channels take off from the Vadavar itself.

The Muvanallur and Mannārgudi channels and the Uadavar No. 1 channel take off from the "Vadavar Extension canal." The continuation of the Vadavar Extension below the head of Vadavar No. 1 channel (R.D. 14/6520) is a major distributary and is styled the "Vadavar Extension Channel." The Palayur and Maharajapuram Channels take off from this channel and Nos. 2 to 12 Channels, Vadavar system, also take off from the same chaunel.

225. *The Puthur Channel.*—This is an existing channel taking off from the left bank of the Vadavar at R.D. 7/9520. It is proposed to remodel this channel and extend it so as to supply an additional area of 5,366 acres.

From the head to 4,290 feet the alignment follows the existing channel.

At the off-take from the Vadavar a new head sluice will be provided. The Pappan Voikal, an existing irrigation channel, is crossed at 0 mile 660 feet by an aqueduct and, as there is not enough headway, it is proposed to provide a sluice in Puthur channel for supply to Pappan Voikal.

From 4,290 feet to 1 mile 1,980 feet the channel will follow a fresh alignment to the left of the existing channel The existing channel will again be picked up at 1 mile 1,980 feet and followed as far as 1 mile 4,950 feet from which point an entirely new alignment has been followed. The old Puthur channel below this point is proposed to be abandoned and its ayacut supplied by sluices direct from the new channel.

"*B*" class bridges are proposed at 0 mile 2,640 feet and 0 mile 3,960 feet for the roads that lead to Satyamangalam railway station and a "*C*" class bridge is proposed at 3 miles 1,720 feet.

There is an isolated high mound near the village of Puthur and the channel will run in contour on the right side of this ridge from 4 miles 660 feet to 5 miles. The small area between the ridge and the channel in this length will not drain into the channel, but will be diverted by the left bank outside the channel.

The Puthur No. 1 *channel* (456 *acres)* will take off at 4 miles 3,564 feet. A "*B*" class bridge is provided at 5 miles 198 feet for the road from Ammapet to Vaduvur.

Puthur No. 2 *channel* (220 *acres*) will take off at 5 miles 3,498 feet and run parallel to the South Indian Railway. The railway line will be crossed by the main channel at 5 miles 3,894 feet and the railway bridge at this place will be combined with a 2-ft. drop. A "*C*" class bridge is proposed at 6 miles 858 feet.

Puthur No. 3 *channel* (1,232 *acres*) will take off at 6 miles 1,518 feet. Below the off-take of No. 3 channel a 2-ft. drop in Puthur channel is provided and a 3-ft. drop at 6 miles 2,508 feet.

Puthur channels Nos. 4 *and* 5.—At 7 miles 528 feet the channel will bifurcate into No. 4 (245 acres) and No. 5 (889 acres) channels.

The No. 4 channel will cross the South Indian Railway at 0 mile 1,584 feet and turn parallel to it. The No. 5 channel is the continuation of the Puthur channel below the last off-take. This channel will cross the surplus channel from Suidan Eri which has a catchment basin of 12 square miles and at this place an aqueduct with 20 spans of 6 feet has been proposed, as the headway available is only 4·25 feet and as the maximum flood discharge to be passed through is 3,144 cusecs.

Puthur No. 3 *channel* (1,232 *acres*) has to cross two valleys—one at 3,630 feet and the other at 2 miles 4,950 feet. In these valleys there are irrigation channels as well as drainage channels. These drainage channels drain large areas and aqueducts of some magnitude are proposed to be constructed.

It may perhaps be cheaper to take up the area at the tail end of this channel under the Chettichatram channel and this may be looked into during execution.

226. *The Chettichatram channel* (1,810 *acres*).—This channel will take off at R.D. 9/1410 of the Vadavar. As there is a high ridge near the head, it will run on contour from head to 3¼ miles. In this length the local drainage between the high ridge and the channel will be received into the channel and disposed of by outlets at 0 mile 4,290 feet and 2 miles 1,914 feet. "*B*" class bridges are proposed at 0 mile 1,320 feet and 2 miles 396 feet. One drop of 2½ feet is proposed at 3 miles 2,970 feet and another drop of 1 foot at 4 miles 330 feet.

Chettichatram channels Nos. 1 *and* 2.—At 4 miles, 2,640 feet the channel will bifurcate into Nos. 1 and 2 channels for irrigating 220 acres and 366 acres respectively.

227. *The Iluppudi channel* (3,030) *acres.*—This is an existing channel taking off at R.D. 10/2036 of the Vadavar. There is a high ridge close to the head of this channel and the channel runs on a contour and feeds the tanks called Sengal Odai Eri and Sitteri. The existing channel will be followed from head to 1 mile, 1,980 feet where a dividing dam will be constructed and the new channel take off on the left side on a higher contour leaving the existing channel to supply its own ayacut.

This new channel will run on contour for another 3,000 feet and then follow the ridge. A 3-ft. drop is proposed at 2 miles, 1,980 feet and a "*B*" class bridge at 2 miles, 3,564 feet. The total length of the channel is 5 miles, 165 feet and a series of drops are provided where found necessary.

228. *The Muvanalur channel* (2,680 *acres*).—This will take off at R.D. 11/4015 of Vadavar Extension canal and will run on contour slightly lower than the ridge for about 7 furlongs from head. At 0 mile, 4,818 feet a "*B*" class bridge with 1-ft. drop combined is proposed on the road to Vaduvur. Two 4-ft drops are proposed—one at 1 mile, 1,551 feet and the other at 2 miles, 1,188 feet—and these will be of the syphon well drop type allowing a roadway across the channel at ground level. A drop of 1 foot is proposed at 2 miles, 3,828 feet. The channel will bifurcate at 3 miles, 528 feet into No. 1 and No. 2 channels for irrigating 433 acres and 1,258 acres respectively.

229. *The Mannargudi channel* (6,151 *acres*) will take off at R.D. 12/6150 of Vadavar Extension canal. It will cross the existing Mannargudi Municipal channel at 0 mile, 3,531 feet and recross it at 7 miles, 4,290 feet. It is not proposed to provide any undertunnel for this channel, but it will be supplied by a sluice from this distributary at 7 miles, 4,340 feet. No special provision for this supply is made in designing the channel as the demand for the Mannargudi town is likely to be only 1 cubic foot per second. However as the Municipal channel supplies the town through tanks and as these have to be filled quickly, the sluice has been designed to discharge 17 cusecs, this being the maximum discharge of the Municipal channel at its head. This supply will generally be given when the demand for irrigation is not the maximum and water to fill tanks can be spared.

Also the drinking water tanks will be filled at the end of the irrigation season before the yearly closure.

Mannargudi channels Nos. 1, 2 *and* 3.—No. 1 channel will take off at 0 mile 3,630 feet for 200 acres. No. 2 channel at 1 mile, 3,300 feet for 246 acres. No. 3 channel off-takes at 2 miles, 1,980 feet for 190 acres.

A drop of 1 foot will be provided just below the head of No. 3 channel and a "*C*" class bridge will be provided at 2 miles, 3,300 feet.

No. 4 *channel* (228 *acres*) will take off at 3 miles, 1,650 feet.

No. 5 *channel* (288 *acres*) takes off at 3 miles, 3,300 feet.

Below the offtake of No. 5 channel a "*B*" class bridge for the road from Tanjore and Mannargudi will be provided over this at 4 miles, 170 feet. Between 4 miles, 3,600 feet and 6 miles, 1,000 feet the channel will run on a contour between Kurikottai and Malavasal and the local drainage in this length will enter the channel and will be disposed of by an outlet at 5 miles, 3,300 feet. The road from Tanjore to Mannargudi will again be crossed at 7 miles, 495 feet and a "*B*" class bridge is proposed here.

Drops of 4 feet and 2 feet are provided at 7 miles, 1,452 feet and 7 miles, 2,970 feet respectively, and a "*B*" class bridge at 8 miles, 1,320 feet for the Pattukkottai-Mannargudi road.

Channels Nos. 6 *and* 7.—At 8 miles, 3,500 feet the channel will bifurcate into No. 6 and No. 7 channels for irrigating 417 and 979 acres respectively.

230. *The Vadavar No.* 1 *channel* (3,310 *acres*) will take off from the end of Vadavar Extension canal at R.D. 14/6520. It will run on contour for the first 1½ miles and for the disposal of the local drainage that enters the channel in this length,

two outlets are proposed—one at 0 mile, 1,452 feet and the other at 1 mile, 1,782 feet. A "*B*" class bridge is proposed at 4 miles, 2,607 feet for the Local Fund road. Between 5 miles and 6 miles, the channel will again run on contour along the side of a small ridge.

The intercepted drainage in this length will not be received into the channel but will be diverted outside the right bank.

A "*B*" class bridge is proposed at 5 miles, 1,815 feet for the District Board road from Madukur to Mannargudi and this bridge will be combined with a regulator for reducing the depth of water in the channel from 2 feet to 1·5 feet. At 6 miles, 3,729 feet the channel will cross the Local Fund road from Mannargudi to Panganadu and a 4-ft. drop combined with a bridge has been proposed here.

231. *The Vadavar Extension channel* (20,960 *acres*) is the continuation of Vadavar Extension canal. The capacity being less than 300 cusecs, it is treated as a distributary. A regulator is provided for the head of this channel. It may be considered during execution whether this regulator may be combined with the "*C*" class bridge at 0 mile, 4,554 feet and a saving in cost effected.

232. *The Vadavar No.* 2 *channel* (319 *acres*) will take off at 0 mile, 660 feet on the right side.

"*C*" class bridges are proposed at 0 mile, 4,554 feet and 1 mile, 2,508 feet, Vadavar channel and Vadavar No. 3 channel will take off at 2 miles, 198 feet for irrigating 1,414 acres.

From 2½ to 3½ miles the channel will run on contour along the side of a high ridge and the small quantity of local drainage will be received into the channel and disposed of by an outlet at 2 miles, 4,158 feet. A "*C*" class bridge is proposed at 3 miles, 1,518 feet.

233. *The Palayur channel* (5,901 *acres*) will take off at 3 miles, 2,310 feet.

A 3-ft. drop in the Vadavar channel is provided just below the head of Palayur channel and a "*B*" class bridge at 4 miles, 1,518 feet.

A 2-ft. drop combined with a bridge is proposed at 4 miles, 4,224 feet.

234. *Vadavar channels Nos.* 4 *to* 12.—*The Vadavar No.* 4 *channel* (995 *acres*) will take off at 5 miles, 3,762 feet.

The channel will run on contour from 6⅜ miles to 8⅛ miles and the local drainage in this length will be received into the channel and disposed of by outlets at 7 miles, 198 feet and 7 miles, 3,234 feet.

The Vadavar channels Nos. 5 *and* 6.—No. 5 channel (523 acres) will take off at 7 miles, 1,650 feet and No. 6 channel (385 acres) at 8 miles, 528 feet.

Below this a 4-ft. drop is proposed at 8 miles, 858 feet and a small saddle will be crossed in embankment at 8 miles, 2,805 feet. *The Maharajapuram channel* (2,991 acres) will take off at 8 miles, 4,158 feet on the left side.

The Vadavar No. 7 *channel* (527 *acres*) will off-take from the same place on the right.

A 2-ft. drop combined with bridge is proposed at 8 miles, 4,422 feet.

The Vadavar No. 8 *channel* (522 *acres*) will take off at 9 miles, 1,650 feet. A 4-ft. drop and bridge is proposed at 9 miles, 2,640 feet.

The Vadavar No. 9 *channel* (187 *acres*) will take off at 9 miles, 3,630 feet for irrigating 187 acres through a tank.

A 2-ft. drop is proposed at 10 miles.

The Vadavar No. 10 *channel* (846 *acres*) will take off at 10 miles, 2,970 feet.

A 3-ft. drop is proposed at 10 miles, 4,950 feet and a bridge at 11 miles, 1,650 feet.

The Vadavar channels Nos. 11 *and* 12.—The channel will bifurcate at 12 miles, 4,290 feet into No. 11 and No. 12 channels for irrigating 278 acres and 522 acres respectively.

235. *The Palayur channel* (5,901 *acres*) will take off at 3 miles, 2,310 feet of Vadavar extension channel and run on a contour for the first 3,000 feet and then follow the Kilpallukkudi ridge. The upland drainage in the first 3,000 feet will be

diverted along the outside the left bank without entering the channel. The channel will again run on contour round the Kattunuluchari ridge and the upland drainage in this length will be received into the channel and disposed of by outlets at 2 miles 2,425 feet and 3 miles, 660 feet.

The Palayur No. 1 channel (401 *acres*) will take off at 3 miles, 5,247 feet. An irrigation channel and a tank supply channel are crossed at 6 miles, 827 feet and 6 miles 1,452 feet and under-tunnels are provided at these places.

The Palayur channels Nos. 2 and 3.—The channel will bifurcate at 6 miles, 3,597 feet into No. 2 and No. 3 channels for irrigating 427 acres and 1,511 acres, respectively.

The No. 3 channel will cross two valleys where irrigation and tank supply channels are met with and at these places under-tunnels have been provided.

236. *The Maharajapuram channel* (2,991) *acres* will take off at 8 miles, 4,158 feet of Vadavar extension channel and run along the Melnatham ridge. A bridge is proposed at 0 mile, 3,432 feet.

No. 1 channel (467 *acres*) will take off at 0 mile, 4,620 feet.

The Maharajapuram channels Nos. 2 and 3.—The Maharajapuram channel will bifurcate at 2 miles 660 feet into No. 2 and No. 3 channels for irrigating 214 acres and 1,503 acres, respectively.

The Maharajapuram channel is the channel that runs along the most rapidly falling country in the Vadavar distributary system, the average fall being as much as 8 feet per mile.

237. *Policy adopted as regards construction at Government cost and at the cost of cultivators of works required to lead water to fields.*—It has been decided on the recommendation of the Inspector-General of Irrigation and in general accordance with the customary procedure that Government will undertake to deliver water at a commanding point in each village, leaving to the ryots the onus of construction of the necessary "water courses" for delivery of water to the fields on the alignments and following the general instructions laid down by Irrigation officers.

The above is subject to the proviso that Government channels shall only be carried into or up to the border of each village to be irrigated when the area to be irrigated is not less than 100 acres, and on the other hand, that the ryots shall not be called on to construct channels of greater capacity than 5 cusecs.

238. *Classification of distributaries into "Major" and "Minor".*—Channels carrying from 300 cusecs to above 25 cusecs are classed as "Major distributaries," while those carrying 25 cusecs and under are classed as "Minor distributaries."

B.—Technical.

239. The bench marks left along the distributaries of the Vadava will be found listed in Vol. II.

The plans connected with the Vadavar distributaries consist of an Index-map, 39 sheets of survey and sections of channels and 75 plans of necessary works including 19 type plans of drops, bridges and sluices.

All these are contained in Portfolios, Nos. 9, 10 and 11.

240. *Description of surveys and data on which the estimates are based.*—For each block, being the area included between two valleys, block maps which are tracings from Revenue Survey village maps (8″ to 1 mile) were prepared.

Levels were taken at somewhat irregular intervals over the area of the block, on lines following the principal features of the ground, at about ½ mile interval and plotted on these block maps. These are referred to as "block levels" or "field levels."

From the "block levels" contour lines were then interpolated on these maps and with these for guidance the approximate alignment of the distributaries were laid out, first on the map, and then on the ground, following the major and minor ridges and spurs. The lines were then levelled over on the ground and such deviations of line made as were desirable.

From these last levels the longitudinal sections and estimates have been prepared.

It is here to be noted that the "block levels" while affording a fairly accurate representation of the contour and levels of the country are not considered sufficiently reliable to base estimates and sections of proposed distributaries on and for this purpose relevelling over the alignment of the proposed channel is considered necessary.

The areas to be irrigated under each distributary have been located and shown on the block-maps and divided into suitable blocks for irrigation by separate "water courses" and pipe sluices and the positions of these located.

At the site of each sluice the convenient bed levels of the distributary channel were noted on the longitudinal section of ground while the fall of channel to give suitable velocity (1·14 Vo to 1·16 Vo) was computed.

The channel bed levels were thus arrived at and drops introduced where called for

This being done, the tabular statement of works for each distributary was prepared, and each item of work designed and estimated for.

241. *General standards of design, grading banks, berms, etc.*—Distributaries are in general designed so as to command their ayacuts at "low water level" which has been taken to be the half-supply level.

Sluices at heads of distributaries taking off from the main and branch canals are provided with sufficient water-way to admit of full supply being passed into distributaries with half supply in the parent canal. Sluices at heads of off-takes that take off from distributaries are provided with vents of a size to pass full supply only with full supply in the parent channel.

The grading for the different channels is based on the permissible velocity which is fixed at 1·14 V to 1·16 Vo (Vo being the critical non-silting velocity required for Punjab sand).

The general grading varies from 0·20 per 1,000 to 0·77 per 1,000 but at tail ends of distributaries where the carrying capacity becomes very small, flatter gradients have been allowed where necessary so that the bed-width of channels shall be not less than 2 feet.

242. *Data for banks, berms, and slopes, etc.*—The banks, berms and width of land provided are in conformity with the particulars furnished in the tabular statement appended.

Statement showing standards of canal cross section.

Item.	Major distributary 25 cusecs and up to 300 cusecs.		Minor distributary under 25 cusecs capacity.		Remarks.
	300 to 150 cusecs.	150 to 25 cusecs.	25 to 10 cusecs.	Below 10 cusecs.	
Width of berm of canal	$4+\frac{d}{2}$	$2+\frac{d}{2}$	$2+\frac{d}{2}$	$2+\frac{d}{2}$	Where d=depth of bed below grounds level in feet. Kutter's co-efficient of rugosity has been taken as 0·0225.
Crest width of widest bank	12 ft.	6 ft.	4 ft	3 ft.	
Crest width of other bank..	6 ft.	6 ft.	4 ft.	3 ft.	
Free board	3 ft.	2 ft.	2 ft.	1½ ft.	
Depth of earth over hydraulic gradient 1 to 4.	1 ft.	1 ft.	1 ft.	1 ft.	
Width of land to be acquired clear of banks when canal is in cutting deeper than balancing depth.	Half the height of bank subject to a minimum of 5 ft.				
Width of land to be acquired clear of banks when canal is in less than balancing depth of cutting.	5 ft. and in addition the full height of the bank above ground.				

NOTE.—It has been settled that "Minor distributaries" should comprise only distributaries of under 25 cusecs capacity.

243. *Land (B).*—The widths of land required have been calculated in confirmity with the provision proposed for berms, banks, margins, etc., and shown in the statement appended to the preceding paragraph. The valuation of the lands in the different villages was obtained from the Special Revenue officer, the land required was tabulated villagewar, and the rates for each different village were adopted to arrive at the total cost of the land acquisition. The average cost of land, held on various tenures as per valuation furnished by the Special Revenue Officer is noted below :—

	RS.	
Government wet	400	per acre.
Do. dry	203	„
Inam wet	342	„
Do. dry	227	„

To the cost worked out as above, 15 per cent has been added for compulsory acquisition as usual. For borrow-pits required for forming embankments where the spoil available from the cutting is not sufficient for the banks required, compensation for temporary occupation has been provided for as per paragraph 271.

244. *Types of sluices and pipe sluices (D).*—The sluices proposed at heads of distributary channels are of the ordinary Madras type provided with screw-gearing shutters. The barrels are generally made wider than the ventway and curved wings are provided in rear, so that the increased velocity through the ventways may be materially reduced before delivery into the earthen channel below the masonry work.

The pipe sluices proposed at the heads of 'water-courses' consist of a head-wall in front with a vent stone, a tail-wall in rear, and earthenware pipes laid in between under the channel banks. The first and last pipes will be set in the masonry of the head and tail walls and the intermediate pipes jointed together with cement mortar will be laid in earth.

Generally, these small sluices have no shutters, but, where the ayacut under the pipe sluice is more than 150 acres a stem shutter is proposed so that regulation may be resorted to in times of scanty supply.

In cases where the lands to be irrigated are on a low level and the water level required for commanding the lands is below the bed level of the channel, a special design with a drop cistern is provided for.

The ordinary types of pipe sluices are embodied in plans Nos. V. 101 to 105 and the special type above mentioned is shown in plans Nos. V. 104 and 105.

245. *Falls and weirs (E)—Types of falls or drops.*—The types adopted are three—

(a) The 'Open Fall' with water cushon.—This is generally applied to drops exceeding 3 feet vertical height, and of capacity exceeding 50 cusecs.

The following data of design have been prescribed for adoption for such works in ordinary cases :—

Length of cistern to foot of slope $\left(\frac{4}{3}\sqrt{Dd}+2d\right)$.

Where d=depth of channel full supply above the fall.

D=difference of bed level of channel above and below work.

Depth of cistern below bed of channel $= \frac{D+d}{3}$

Reserve slope cushon 1 in 3.
All revetments to be 1 foot above F.S.L.
Length of side revetment to be—
Above work $(5+4d)$.
Below work clear of cushon $(20+6d\sqrt{D})$.

The bed of the canal to be pitched with dry packed masonry above and below the work for a length equal half the length of side revetment.

The water flow to be regulated by trapezoidal notches shaped on the following rules and with discharges computed from Nethersole's Tables.

The sides of the notches to be circular arcs struck with a radius T where the drop wall is straight, and $\frac{3}{4}$ T where the drop wall is curved, in plan.

The centres to be on a line $\frac{T}{4}$ from the downstream face of the drop wall.

(T=thickness of drop wall at cill level.)

A spreader stone or lip to be provided, the edge of the lip being circular and projecting 1 foot beyond the downstream face of the drop wall.

(*b*) *'Open fall' with solid apron.*—This is applied to all capacities of channel when the fall (D) is 3 feet or under.

The apron is of concrete surfaced with $4\frac{1}{2}''$ brick Plastered with Portland cement. The length of apron, $\frac{4\sqrt{Dd}}{3}+2d$ Revetment, pitching and arrangements of trapezoidal notches are as for type (*a*).

(*c*) *The "Syphon well" drop.*—This is applied to all falls exceeding 3 feet when the capacity is 50 cusecs or under.

Also to capacities up to 100 cusecs when a bridge is required at the same place.

This type of work is (in Madras at any rate) a new type as applied to drops although it is not uncommonly used in a modified form for cross drainage works.

The advantages claimed for the type are—

(1) For small capacity drops over about 3 feet in height it is cheap in comparison to the open fall with water cushon and the higher the fall the greater the economy.

(2) The type provides a bridge over the channel.

(3) The action of water on issue from the tail end of the work is much less violent than in the case of the open fall.

An experimental syphon well drop erected for trial of the type at Red Hills near Madras has given thoroughly satisfactory results. (Described in Circular Irrigation Branch No. 588 of 17th April 1910).

The type is clearly shown in the plans (Nos. V 111 to 114).

246. *Data of design syphon well drops.*—The data for design are noted below:—

For Internal Diameter of drop well.

Capacity of drop up to 10 cusecs—				
When D is over 3 and up to	4 feet	diameter of well	...	4 feet.
" D " 4 "	8 "	" "	...	5 "
" D " 8 "	10 "	" "	...	6 "
Capacity over 10 cusecs and up to 18 cusecs—				
When D is ver 3 and up to	6 feet	diameter of well	...	5 feet.
" D " 6 "	8 "	" "	...	6 "
" D " 8 "	10 "	" "	...	7 "
Capacity over 18 cusecs and up to 25 cusecs—				
When D is over 3 and up to	6 feet	diameter of well	...	6 feet.
" D " 6 "	10 "	" "	...	7 "

The internal diameter of delivery well to be 4 feet.—The width of the circular cistern round the delivery well and clear of its external diameter to be half the bottom width of the channel below subject to a maximum of $4\frac{1}{2}$ feet.

Revetment and pitching above the work to be the same as for the 'Open Falls'.

Revetment and pitching below the work clear of the circular cistern to extend one half the length of that below the 'Open fall'.

Above the work and in the immediate vicinity the approach banks to be 3 feet above F.S.L. and the top of the drop well to be 4 feet above F.S.L.

Entry to the drop well to be through a trapezoidal notch made on the following data:—

Sides of notch segmental struck with radius $\frac{3T}{4}$ from centres in a line $\frac{T}{4}$ from the downstream face of the drop wall. Curve on the downstream edge of the notch sides to have radius $\frac{T}{3}$.

The lip to be a circular arc projecting 1 foot over the downstream face.

T = thickness of steining of the well.

The well drops provided to be plastered throughout with ¾ inch thick Portland cement rendering.

The size of the orifice giving exit from the drop well to the culvert to be computed to keep water in the drop well when passing full supply about ½ foot below the cill of the trapezoidal notch.

The length of culverts or of wings of all drops or falls to be designed for a hydraulic gradient 1 in 5.

(Further details regarding types of drops will be found in Special Superintending Engineer's file 111 G 'Types of Drops', Kistna Reservoir project.)

Well drops of various types were designed for large capacity and appear promising, but, having no opportunity of trial of such large drops, the estimates for the project works only provide this type of drop for the small capacities.

247. *Cross-drainage works* (*F*).—The distributary channels are aligned as far as practicable on ridges and consequently there are only a very limited number of cross-drainage works. In cases where channels are taken on contour round isolated high mounds the drainages from the small areas intercepted are proposed to be taken into the channels and outlets at suitable places are provided. Such outlets are provided at the following places :—

Chettichatram channel ...	0 mile 4,290 feet and 2 miles 1,914 feet.
Mannārgudi channel	5 miles 3,300 feet.
Vadavar No. 1 channel ...	0 mile 1,452 feet and 1 mile 1,782 feet.
Vadavar Extension channel ...	2 miles 4,158 feet, 7 miles 193 feet and 7 miles 3,254 feet.
Palayur channel	2 miles 2,475 feet and 3 miles 660 feet.

Irrigation and tank supply channels are crossed at the places noted as fallows and suitable under-tunnels have been provided :—

Puthur No. 3 channel ...	0 mile 4,158 feet, 0 mile 4,356 feet, 1 mile 0 foot and 2 miles 4,686 feet.
Muvanallur No. 1 channel ...	0 mile 3,630 feet.
Palayur channel	6 miles 827 feet and 6 miles 1,452 feet.
Palaiyur No. 3 channel ...	0 mile 1,782 feet, 0 mile 2,310 feet, 2 miles 594 feet and 2 miles 2,514 feet.

The most important of the cross-drainage works are at 0 mile 3,630 feet and 2 miles 4,950 feet of Puthur No. 3 channel, and 1 mile 2,640 feet of Puthur No. 5 channel, the areas drained being 10·56, 95 and 12 square miles, respectively. Masonry aqueducts for the proposed channels have been provided at these places (as described in paragraph 253).

248. *Bridges* (*G*).—On the distributary channels bridges have as far as possible been combined with drops. Except in cases where 'Syphon well drop' types are adopted, the water-way for bridges provided is very nearly the normal water-way of the channel.

For spans of 15 feet and above steel girder bridges of the standard types described in paragraphs 181–183 have been provided in order to reduce as far as possible the demand for masons during construction.

For spans of under 15 feet bridges with brick arches have been proposed and types have been drawn for spans of 4 feet, 6 feet, 8 feet, 10 feet and 12 feet The rise of the arch is proposed to be 2 feet in all cases and the height to springing line of arch is very nearly the ordinary F.S.L. of the channel. The width of roadway shown on the type-designs is 14 feet but in preparing estimates for the class of bridge proposed, necessary provision has been made for easily computing difference of cost for a change in the width. These brick arch bridges are all proposed to be only single span bridges—vide plans Nos. V. 98 to 100.

249. *Where bridges are to be provided.*—The provision of bridges have been proposed in the following cases :—

(1) For all District Board road crossings whether metalled or not.

(2) For all recognized cart-tracks (when not very close together) crossing channels when the depth of water at full supply exceeds 2·5 feet or in alternative when F.S.L. of the channel is carried more than 2 feet above ground level.

(3) In all other cases only earthen ramps are proposed for crossings of distributaries. The soil is sandy loam and when subjected to running water the crossings in this soil becomes pure sand which offer no difficulties to crossing by carts or foot traffic.

250. *Earthwork (L).*—There are no deep cuttings or high embankments worth special description and the few that deserve mention have been dealt with under 'Description of distributary channels'. The soil to be cut through is all sandy loam.

251. *Miscellaneous (O).*—Under the sub-head 'O. Miscellaneous' provision is made for demarcation stones (Revenue Survey stones) and mile and furlong stones. Some of these latter will be utilized as bench-mark stones.

252. *Maintenance (P).*—Provision is made at the rate of Rs. 100 per mile for major distributaries and Rs. 25 for minor distributaries for maintenance of completed portions during construction.

253. *Description of special works—Bridges combined with falls.*—Besides combined falls and bridges of 'the Syphon well drop' type already described 'open falls' with solid aprons to be provided at or near bridges have been combined with the bridges for the sake of economy as follows: Open falls of 3 feet and under are provided for by introducing a wall in front of the bridge and providing necessary notches therein. The roadway in these cases will be at a suitable level to correspond with the F.S.L. in front of the drop. Full details of these workers are contained in plans Nos. V. 159, 176, 194, 197, 212 and 216.

Dividing dam at 1 mile 1,980 feet of Iluppudi channel.—This work has been introduced for the purpose of automatically regulating the supply to the Illuppudi channel and its extension. The extension runs on a higher level and takes off without any drop in bed. The existing Iluppudi channel which runs on a lower level has to be provided with a drop. The water-ways provided in the dividing dam are trapezoidal notches designed to carry proportionate supply with any depth in front.

In the drop-wall two vents (each 1 foot wide), one on each side of the trapezoidal notch will be provided and fitted with plank shutters for the purpose of sending down a copious supply when available, for filling the tanks Sitteri and Sengal Odai eri.

Under these conditions there can be no complaint that the existing Iluppudi irrigation has been deprived of its supply.

Aqueducts to carry the Puthur channel off-takes over drainage courses.—The drainage courses are of some magnitude and the headway available is very limited. Steel trough aqueducts were first thought of but as steel is liable to corrosion, it has been thought desirable to go in only for a masonry trough aqueduct. On account of the limited headway available only 6 feet spans with 1 foot 6 inches rise and segmental arches 1 foot 1½ inches thick are proposed as shown on plans Nos. V. 134 and 136. The top of the arches will be plastered with cement ¾ inches thick so that after completion of work the net thickness of the archwork and plaster will be less than 1 foot 2¼ inches or say 1 foot 3 inches.

SECTION IX.

Distributaries—Grand Anicut Canal System.

254. *Distributaries not estimated or aligned in detail.*—The distributaries of the Grand Anicut canal system have not been investigated in detail. The positions of the different off-takes and their probable alignments have been shown on the contour maps (plans Nos. G-1 to G-3). With the aid of these contour maps, the areas to be served by the different off-takes have been determined and also the areas to be served 'direct' from the main canal and branches. The different off-takes have also been classified into 'major' and 'minor' distributaries, and the results are tabulated in statement I.

In the case of areas 'irrigated direct' from main canals and branches meaning cases where the sluices in these canals discharge direct into 'Water courses', the pipe sluices required at the points of off-take are provided for under 'Main canals and branches', sub-head '(O) Miscellaneous.' In estimating, therefore, the cost of the distributaries per acre irrigated the extent proposed to be irrigated 'direct' from the main canals and branches will be left out of account, as no distributaries will be needed for this area, and only the areas supplied from major and minor distributaries will be estimated for under 'Distributaries.'

255. *Vadavar distributaries taken as 'Typical system'.*—The distributaries of the Vadavar system have been investigated in detail, the alignment of each distributary has actually been laid out on the ground and levelled over and from the delta so obtained detailed estimates have been prepared. The area to be served by the Grand Anicut canal system is similar in features and general configuration of ground and nature of soil and sub-soil to that of the Vadavar system, and the fall of the country along the lines of the proposed distributaries is also not very different.

256. *Allowance for steeper fall of country.*—The Vadavar system distributaries are aligned along ground falling generally from 3 feet to 6 feet per mile, and the Grand Anicut canal distributaries on ground falling generally from 4 feet to 6 feet per mile.

The steeper fall of the country under the Grand Anicut canal system will entail extra expenditure on 'Falls' and it is proposed that the extra cost on account of falls be estimated in proportion to the steepness of the country on the assumption that the cost of 'falls' required will be greater in the same proportion. The average fall of the country in the case of the Vadavar system is 4·8 feet per mile, and in the case of Grand Anicut canal system 5·7 feet per mile. The cost of 'falls' in the case of the Grand Anicut canal distributaries will therefore be $\frac{0 \cdot 9}{4 \cdot 8}$ or 18·8 per cent higher than in the case of the Vadavar distributaries and this has been provided for in working out the rates for the Grand Anicut canal distributaries from the Vadavar 'typical area'—vide column 8 of statements II and III and last line of statement IV. Out of the distributaries of the Vadavar system the Puthur and Iluppudi channels are existing channels proposed to be improved and extended and these channels are not taken as 'typical' in working out the average cost of distributaries.

257. *Details of typical distributary system.*—The area available as 'Typical area' is 34,911 acres as detailed below :—

	ACS.
Minor distributaries.	
Chettichatram channel	1,810
Total, Major distributaries ...	1,810
Major distributaries.	
Muvanallur channel	2,680
Mannārgudi channel	6,151
Vadavar No. 1	3,310
Vadavar Extension channel	20,960
Total, Major distributaries ...	33,101
Grand Total, Typical area ...	34,911

In the 'Typical area' the Chettichatram channel is the only 'Minor' taking off direct from the main canal but from the major distributaries detailed above, there are minor distributaries taking off.

These minor distributaries irrigate 15,300 acres out of the total area of 33,101 acres as detailed below :—

	ACS.
Muvanallur No. 1 channel	433
Do. No. 2 do.	1,258
Total ...	1,691
Mannārgudi No. 1 channel	200
Do. No. 2 do.	246
Do. No. 3 do.	190
Do. No. 4 do.	228
Do. No. 5 do.	288
Do. No. 6 do.	417
Do. No. 7 do.	979
Total ...	2,548
Vadavar No. 2 channel	319
Do. No. 3 do.	1,414
Do. No. 4 do.	995
Do. No. 5 do.	523
Do. No. 6 do.	385
Do. No. 7 do.	527
Do. No. 8 do.	522
Do. No. 9 do.	187
Do. No. 10 do.	846
Do. No. 11 do.	278
Do. No. 12 do.	522
Total ...	6,518
Palaiyur No. 1 channel	401
Do. No. 2 do.	427
Do. No. 3 do.	1,511
Total ...	2,339
Maharajapuram No. 1 channel	487
Do. No. 2 do.	214
Do. No. 3 do.	1,503
Total ...	2,204
Grand Total ...	15,300

The area irrigated by minor distributaries taking off from major distributaries forms therefore $\frac{15,300}{33,101} \times 100$ or 46·22 per cent of the gross area irrigated by major distributaries, the balance being irrigated 'direct' from the major distributaries.

This proportion is applied to the Grand Anicut canal system in working out the area to be served by minor distributaries.

258. *Areas under distributaries, Grand Anicut.*—The total area under the proposed Grand Anicut canal is 286,305 acres, of which 13,842 acres is to be irrigated 'direct' from the main and branch canals; 242,163 acres comes under major distributaries and 30,300 acres under those minor distributaries, which take off 'direct' from main and branch canals, as shown in statement I.

Applying the centage arrived at for the Vadavar system, the area that will have to be served under minor distributaries taking off from major distributaries will be $\frac{242,163 \times 46 \cdot 22}{100}$ =111,928 acres. The independent 'minors' will irrigate 30,300 acres and thus the total area to be irrigated under 'minor distributaries' is thus computed at 142,228 acres.

The cost of major distributaries, including that of their "minors" is worked out in statement II, and the average cost per acre irrigated is shown in column 7. The rate arrived at, if applied to the major distributary system, will give the cost of this system *including* that of its "minors."

The cost of major distributaries *excluding* the cost of the minor distributaries taking off from them is worked out in statement III and the average cost per acre irrigated is shown in column 7. This rate, if applied to the major distributary system, will give only the cost of the system *excluding* "minors."

259. *Systems of computing cost of distributaries.*—In order to arrive at the total cost of the system the area served by the minor distributaries taking off from the majors should be separated out and added to area coming under minor distributaries taking off direct from main or branch canals. The sum should be multiplied by the cost of "minors" per acre at the rates shown in statement IV and this added to the cost for majors worked out at the rates in statement III.

The cost of the "minor distributaries" is worked out in statement IV and the average cost per acre irrigated is shown in column 30. In this statement the independent minor distributary, *viz.*, the Chettichatram channel, and all minor distributaries taking off from major distributaries are included for the purpose of working out the average cost. The rate arrived at, if multiplied by the area in acres under minor distributaries, will give the cost of the whole system served by minor distributaries.

In working out the estimate of cost of the Grand Anicut canal distributaries, the rates arrived at as per statements III and IV have been adopted.

The rates entered in column 8 of statement III and the last line of statement IV are the rates to be applied to Grand Anicut canal system, and these rates contain the extra provision required for the steeper country on account of extra falls. The cost of the Grand Anicut canal distributaries worked out on the above lines is shown in statement V.

260. *Another system of working out cost of distributaries.*—The total worked out from the rates in statements II and IV is noted below for comparison :—

—	Acres.	Rate.	Cost.
		RS.	RS.
Irrigated gross area supplied under major distributaries	242,163	11·69	28,30,885
Area under minor distributaries "irrigating direct" from main canals and branches.	30,300	7·28	220,584
Total ..	..	..	30,51,469

Comparing this with the total of statement V, column 6, obtained from statements III and IV the difference (Rs. 20,542) is immaterial.

Statement I.

Statement of areas distributed under Grand Anicut Canal System.

Description.	Ayacut acres.			Total.
	Major distributary.	Minor distributary	Direct irrigation.	
(1)	(2)	(3)	(4)	(5)
	ACS.	ACS.	ACS.	ACS.
Main canal	114,035	13,191	8,627	135,663
Kalianodai branch	45,014	8,092	1,777	54,883
Vadakadu do.	25,551	5,524	1,861	32,936
Rajamadam do.	21,590	2,833	1,167	25,590
Pudupatnam do.	35,973	660	410	37,043
Total ..	242,163	30,300	13,842	286,305

STATEMENT II.

Statement showing the average rate for major distributary including the minor channels that take off from them in rupees.

Sub-heads.	Ayacut acres.	2,680	6,151	3,310	20,960	33,101	Cost per acre irrigated "Typical area".	Cost per acre for "Grand Anicut Canal System."
	Names of channels.	Muvanallur channel.	Mannargudi channel.	Vadavar Number 1 channel.	Vadavar extension.	Total cost.		
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Preliminary Expenses ..		1,170	2,740	1,550	9,030	14,490	0·44	0·44
B. Land		12,490	26,070	13,450	84,915	1,36,925	4·13	4·13
C. Works. Falls and weirs.		3,910	3,735	2,590	27,140	37,375	1·13	1·34
C. Works. Cross drainage works.		620	500	770	19,850	21,740	0·66	0·66
C. Works. Otherworks ..		2,320	12,085	3,710	38,745	56,860	1·72	1·72
L. Earthwork		6,080	16,200	11,900	71,440	1,05,620	3·19	3·19
O. Miscellaneous		235	480	220	1,220	2,155	0·07	0·07
P. Maintenance		380	990	740	2,595	4,705	0·14	0·14
Total ..		27,205	62,800	34,930	2,54,935	3,79,870	11·48	11·69

STATEMENT III.

Statement showing the average cost of major distributary area excluding the minor channels that take off from them in rupees.

Sub-heads.	Ayacut acres.	2,680	6,151	3,310	20,960	33,101	Cost per acre irrigated "Typical area."	Rate per acre proposed for "Grand Anicut Canal System."
	Names of channels.	Muvanallur channel.	Mannargudi channel.	Vadavar Number 1 channel.	Vadavar extension channel.	Total.		
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Preliminary Expenses ..		500	1,745	1,550	4,635	8,430	0·25	0·25
B. Land		7,620	21,100	13,450	58,610	1,00,780	3·05	3·05
C. Works. Falls and weirs.		2,370	945	2,590	17,030	22,935	0·69	0·82 } 2·42
C. Works. Cross drainage works.		..	500	770	9,090	10,360	0·31	0·31 } 2·42
C. Works. Other works ..		1,175	9,450	3,710	28,250	42,585	1·29	1·29 } 2·42
L. Earthwork		3,300	13,630	11,900	54,850	83,680	2·53	2·53
O. Miscellaneous		120	305	220	665	1,310	0·04	0·04
P. Maintenance		310	865	740	2,165	4,080	0·12	0·12
Total ..		15,395	48,540	34,930	1,75,295	2,74,160	8·28	8·41

STATEMENT IV.

Statement showing the estimated cost of "Minor Distributaries" in rupees.

Names of channels.	Ayacut acres.	Sub-heads, A. Preliminary expenses.	B. Land.	C. Works. Falls and weirs.	C. Works. Cross drainage works.	C. Works. Other works.	L. Earthwork.	O. Miscellaneous.	P. Maintenance.	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Chettichatram channel.	1,810	740	5,680	750	1,060	3,585	4,010	155	135	16,115
Muvanallur No. 1 channel.	433	170	1,200	540	620	415	[illegible]	35	20	3,600
Muvanallur No. 2 channel.	1,258	500	3,670	1,000	..	730	2,180	80	50	8,210
Mannargudi No. 1 channel.	200	80	285	610	..	170	100	15	10	1,270
Mannargudi No. 2 channel.	246	100	200	..	..	100	65	20	15	500
Mannargudi No. 3 channel.	190	50	300	260	..	120	150	15	10	905
Mannargudi No. 4 channel.	228	90	560	..	..	100	125	10	10	895
Mannargudi No. 5 channel.	288	120	1,075	290	..	215	240	25	20	1,985
Mannargudi No. 6 channel.	417	170	1,050	1,105	..	950	910	40	25	4,250
Mannargudi No. 7 channel.	979	385	1,500	525	..	980	980	50	35	4,455
Vadavar No. 2 channel.	319	130	1,670	..	..	220	470	25	20	2,535
Vadavar No. 3 channel.	1,414	560	3,540	..	..	1,630	2,990	65	50	8,835
Vadavar No. 4 channel.	995	400	2,550	2,210	..	1,410	1,230	45	40	7,885
Vadavar No. 5 channel.	523	210	840	790	..	485	330	20	15	2,690
Vadavar No. 6 channel.	385	150	320	..	..	185	70	10	5	740
Vadavar No. 7 channel.	527	205	730	245	..	425	200	25	15	1,845
Vadavar No. 8 channel.	522	200	620	620	..	475	230	10	10	2,165
Vadavar No. 9 channel.	187	80	440	290	..	70	140	10	10	1,040
Vadavar No. 10 channel.	846	330	1,300	2,000	..	840	490	25	20	5,005
Vadavar No. 11 channel.	278	110	640	..	..	190	140	10	10	1,100
Vadavar No. 12 channel.	522	210	1,980	860	..	410	1,780	45	35	5,320
Palayur No. I channel.	401	160	520	290	..	515	340	25	20	1,870
Palayur No. II channel.	427	170	1,265	505	..	390	460	20	15	2,825
Palayur No. III channel.	1,511	610	6,750	260	10,760	1,405	5,280	95	75	25,235
Maharajapuram No. I channel.	487	190	450	300	..	365	130	40	30	1,505
Maharajapuram No. II channel	214	90	350	550	..	725	220	15	10	1,960
Maharajapuram No. III channel.	1,503	590	2,340	1,190	..	755	2,090	70	50	7,085
Total cost ..	17,110	6,800	41,825	15,190	12,440	17,860	25,950	1,000	760	1,21,825
Cost per acre irrigated "Typical system".	..	0·40	2·44	0·89	0·73	1·04	1·52	0·06	0·04	7·12
Rate per acre proposed for 'Grand Anicut Canal System."	..	0·40	2·44	1·05	0·73	1·04	1·52	9·06	0·04	7 28
				2·82 (cols. 5–7)						

Statement V.

Cost of Grand Anicut Canal distributaries allocated by sub-heads in rupees including provision for unforeseen contingencies.

Sub-heads.	Major distributary area, 242,163 acres.		Minor distributary area, 142,228 acres.		Total amount, rupees.	Add 20 per cent for unforeseen contingencies, rupees.	Grand total amount, rupees.
	Rate per acre, rupees.	Amount, rupees.	Rate per acre, rupees.	Amount, rupees.			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
A. Preliminary Expenses ..	0·25	60,541	0·40	56,891	1,17,432	..	1,17,432
B. Land	3·05	7,38,597	2·44	3,47,036	10,85,633	2,17,167	13,02,800
C. Works	2·42	5,86,034	2·82	4,01,083	9,87,117	1,97,483	11,84,600
L. Earthwork	2·53	6,12,672	1·52	2,16,187	8,28,859	1,65,741	9,94,600
O. Miscellaneous	0·04	9,687	0·06	8,534	18,221	3,679	21,900
P. Maintenance	0·12	29,060	0·04	5,689	34,749	6,951	41,700
Total ..	8·41	20,36,591	7·28	10,35,420	30,72,011	5,91,021	36,63,032

SECTION X.

Rates and Building Materials.

261. *Imported building materials.*—Reference to the map of the irrigated area will show the general alignment of roads and railways, and it will be seen that there are reasonable facilities for distributing over the area imported materials (such as iron and steel and Portland cement) required for the works.

262. *Local building materials.*—Most of the building material required is of local manufacture and is that required for masonry works which in the case of these works are generally of brickwork and broken brick concrete.

263. *General nature of the soil.*—The surface soil throughout the tract to be irrigated is, generally speaking, a red or yellow sandy loam with a considerable admixture of impervious yellow clay. The sand is course sharp sand and on the surface the large proportion of sand in the soil is very noticeable. A few feet from the surface, however, it is found the soil is only with difficulty permeable by water, and as a result in the greater part of the tract sub-soil water is found from 5 to 20 feet from the surface. The appearance of the surface is very sandy owing to the washing away of the plastic constituents of the soil by rain and the soil appears for this reason much more absorbent than it really is. Here and there on ridges a lateritic formation is met with. Vallam ridge is of this nature, and on this and in a few other places laterite stone and gravel is obtainable.

In the vicinity of Arantanghi there are large formations of laterite.

264 *Sand.*—From the above description it will be clear that good building sand will be obtainable in the bed of all streams and this is the case.

265. *Lime kunkur.*—The soil in most parts is freely admixed with nodules of kunkur, but this material is generally found more plentifully in the beds of all the larger streams, and it is from these places it is generally quarried.

The kunkur is distributed all through the tract to be irrigated, but the quantities of deposits in any one place are not generally great, and hence the high rate allowed for lime.

266. *Bricks.*—Good brick earth is obtainable in the alluvial margins of the Vennar and other considerable streams. Generally bricks are made of local soil throughout the tract, but the bricks are sandy and brittle and could not be relied on for works of considerable size or importance.

For cross drainage works and more important works on the main canal and branches, provision is made for making bricks from the nearest deposit of good brick earth and carting them whatever distance may be necessary. For small works only the local bricks are provided for and all such works are to be plastered with Portland cement to protect them from the action of the weather.

That such bricks are sufficiently good for such works is seen from the existing local irrigation works and buildings constructed of such bricks.

267. *Water.*—Water is found near the surface throughout the tract and there will be no difficulty in getting ample supplies for masonry works.

268. *Firewood.*—The country generally is well grown with trees in hedges and along boundaries.

Along the coast and on more sandy tracts casuarina trees are grown for firewood as a regular industry, but with these exceptions there are no woods.

Firewood for brick and lime burning will be obtainable without difficulty for the smaller scattered works, but there may be difficulty in the case of a few of the larger aqueducts on the main canal which are far away from a railway and for which large quantities of bricks will be required (*e.g.*, aqueduct over the Agniar). It might be desirable to arrange for growing casuarina topes in the vicinity of the sites of a few such works. If such topes are planted within eighteen months of the sanction of the project, the wood would be fit five years later for firewood.

269. *Labour for earthwork.*—The larger earthwork must be done by imported labour as the local labour is insufficient and is already fully employed.

The rates allowed are very materially higher than the local rates which are only sufficient for execution by local labour in times when labour in the fields is slack.

270. *Labour for masonry work.*—The masonry is all brickwork and whatever local masons there are accustomed to this class of work.

There are no stone masons in the tract to be irrigated.

It will undoubtedly be necessary to import brick-layers to supplement the local supply. The total quantity of brick masonry required is great but nothing like the quantity of masonry in the head works, and it is fortunate that for the latter work a different class of mason is required so that the demands for the head works and distribution works will not clash as regards labour for masonry works.

271. *Land for digging pits.*—Where land is required temporarily for digging pits for forming banks the cost of this is provided for at so much per unit of earth to be taken.

It will lie with the officer carrying out the work whether he will acquire the land required temporarily or will arrange with the ryots to pay for earth taken from their lands without acquisition.

The latter is a common practice in Tanjore and the District Board rate for the same is $9\frac{1}{4}$ annas per unit.

In the project estimate 10 annas per unit is allowed which works out to a rate of Rs. 82 per acre for pits 3 feet deep. This is a liberal rate and will cover permanent acquisition in those places where permanent injury is done to the lands. The item appears in the estimates under B. Land.

272. *Earthwork rates.*—The rate for earthwork excavation includes in the initial rate breaking up clods, levelling and sectioning both banks and cuttings, laying earth in layers, but does not include ramming or watering earthwork.

It includes lead-up to 20 yards measured, for purposes of estimate, from the centre of the excavation to the centre of the bank.

It includes "lift" up to two yards measured, for purposes of the estimate, as the difference of level between the centre of gravity of the excavation to the centre of gravity of the bank.

One increment of lead or lift is given for each extra 10 yards lead or 1 yard lift or part of this over the initial lead or lift.

273. *Local rates.*—The local rates for unskilled labour shown in the schedule of rates now current in the Tanjore district are fairly representative of general rates in the southern districts of the Madras Presidency for execution of ordinary repairs works, utilizing only local labour and taking advantage of the seasons when demand for agricultural and ordinary unskilled labour is low. The rates for masonry works shown in the column 2 (District Board rates) have recently been revised by an officer of much local experience and may be accepted with confidence. Such rates cannot be worked to where works demanding large quantities of labour have to be pushed on rapidly. It will be seen that the rates provided for are in excess of these, and greatly in excess for such items as involve much labour, especially for earthwork.

274. *Remarks on rates.*—The rates for the distributary system are divided into two sets.

One set of rates does not generally include carriage of material, and to these the cost of this has to be added for each work in accordance with the distance of the work from the sites from which material has to be carried.

These rates have been used in estimating for the "Main canals and branches".

The other set of rates has been used for estimating for the cost of "distributaries" and these rates make allowance for a fair average lead for materials.

The masonry works provided for in "distributaries" are very numerous, scattered and small; the nature of the works are such that it will not be necessary to insist on high quality of bricks being used as in the case of the more important works on "Main canals and branches".

The whole country provides within a radius of a mile earth suitable for an inferior class of brick and the rates for distributaries provide for use of the best local earth allowing for one mile lead.

For lime, a lead of three miles is allowed for in the rates, and for sand one mile.

All the works on the "Vadavar system" are allowed for at the rates provided for the "distributaries" as in the case of this canal material can be obtained within the leads included in these rates.

275. *Allowance for unforeseen works.*—The estimate submitted allows reasonable and liberal rates for the work to be done having in view the existing rates and the necessity for importing labour. The increasing demand for labour due to industrial development, and the rises in prices of food-grains, are factors which may lead to material increase in the wage to be paid to artizans and unskilled labourers in the not distant future. To cover any such cause of extra expenditure as well as to provide for unforeseen works, a sum amounting to 20 per cent over the cost of distribution works as estimated is allowed under "Unforeseen works." It is suggested that such sum shall be retained as a reserve in the hands of the Chief Engineer and shall not be trenched on without the sanction of that officer.

STATEMENT OF RATES—DISTRIBUTION SYSTEM.

Materials.

(Figures in thick type give prices including cost of carriage to site.)

Nature of work. (1)		Schedule rate, District Board Engineer, Tanjore. (2)	Vennar or Cauvery division, Public Works Department. (3)	Project rate, "Main canal and branches" (4)	Project rate, "Distributaries." (5)
		RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
Table-moulded stock bricks, $9 \times 4\frac{3}{8} \times 2\frac{1}{2}$	per 1,000	8 12 0	8 12 0	10 0 0	..
Platform moulded bricks, $9 \times 4\frac{3}{8} \times 2\frac{1}{4}$	,,	..	7 0 0	8 0 0	9 0 0
Native bricks, 9" × 4" × 2"	,,	..	5 0 0	5 8 0	6 0 0
Brick jelly, vitrified and broken, for concrete and backing	100 c.ft.	6 0 0	..	8 8 0	10 0 0
Cuddapah slabs, 2" thick, at Tanjore	100 sq. ft.	..	18 12 0	18 0 0	18 0 0
Do. 4" do.	100 ,,	..	..	..	36 0 0
Cut granite stone or gneiss dressed square and true and delivered at site	C.ft.	1 10 0	1 8 0	1 12 0	2 8 0
Cut granite stone or gneiss fine dressed or special shapes	,,	2 0 0	2 0 0	2 0 0	
Rough stone broken for concrete, 2" gauge	100 c ft.	2 0 0	..	5 8 0	..
Lime stone burnt and delivered..	100 ,,	21 14 0	18 15 0	20 0 0	22 0 0
Laterite metal broken to 3 inches	100 ,,	0 13 0	..	1 12 0	..
Laterite gravel screen and stacked	100 ,,	0 11 6	0 14 6	1 0 0	1 0 0
Gravel	100 ,,	0 11 6	1 0 0	1 0 0	1 0 0
Rough stone quarrying and stacking when the stone can be removed with crowbar	100 ,,	2 8 0	..	3 8 0	..
Rough stone quarrying and stacking when blasting is required	100 ,,	5 0 0	7 0 0	7 0 0	7 0 0
Laterite roughly squared	100 ,,	..	..	7 8 0	..
Laterite blocks squared and ready for building ..	100 ,,	11 0 0	..	12 0 0	..
Laterite rough rubble	100 ,,	..	..	5 0 0	..
Quarrying and breaking metal from boulders to	2" ring.	..	..	4 0 0	4 0 0
	1½" ,,	..	..		
Digging and breaking quartz or moorum or laterite to	2" ,,	..	..	3 0 0	3 0 0
	1½" ,,	..	..		
Collecting off surface of fields and breaking quartz, pebbles or other stones.	2" ,,	..	..	2 8 0	2 8 0
	1½" ,,	..	..	3 0 0	3 0 0

Statement of Rates—Distribution System.

Complete works.

(Figures in thick type give prices including cost of carriage to site.)

Nature of work. (2)	Unit	Schedule rate, District Board Engineer, Tanjore. (2)	Vennar or Cauvery division, Public Works Department. (3)	Project rate, "Main canal and branches." (4)	Project rate, "Distributaries." (5)
		Rs. A. P.	Rs. A. P.	Rs. A. P.	Rs. A. P.
Earthwork.					
Excavating in sand	1,000 c.ft.	2 0 0	2 0 0	2 12 0	2 12 0
Do. and filling	do.	3 0 0	3 7 6	4 0 0	4 0 0
Do. in ordinary loam, alluvial or black soil ..	do.	2 5 0	2 5 0	3 12 0	3 12 0
Do. hard clay with gravel	do.	3 0 0	..	5 0 0	5 0 0
Do. hard gravel	do.	3 8 0	..	6 0 0	..
Do. soft rock	do.	5 0 0	..	Rs. 6 to 18	..
Do. Tanjore lateritic sand stone	do.	..	..	9 0 0	..
Each increment of 10 yards lead or 1 yard lift or part of these per	do.	0 3 0	0 3 1	0 4 6	0 4 6
Leading earthwork, etc., by tram line in trucks including repairs and laying and shifting lines but exclusive of tools and plant or by bullock cart per 1,000 c.ft. including loading and unloading, up to	1,000 ft.	..	..	6 0 0	..
Leading earthwork, etc., by tram line in trucks including repairs and laying and shifting lines but exclusive of tools and plant or by bullock cart per 1,000 c ft. including loading and unloading, for each additional	do.	..	..	1 8 0	..
Blasting rock (measured in the solid)	100 c.ft.	..	..	7 0 0	7 0 0
Concrete.					
Broken vitrified brick in chunam	100 c.ft.	14 0 0	13 8 0	17 0 0	19 0 0
Do. stone in lime mortar	do.	..	..	14 0 0	16 0 0
Do. vitrified brick in surki mortar	do.	16 0 0	16 0 0	18 8 0	21 0 0
Do. stone in surki mortar	do.	..	..	15 8 0	..
Brickwork.					
Table-moulded brick in lime mortar (9 × 4⅜ × 2½)		22 0 0	19 8 0	22 8 0	..
Do in flat or circular arch work		..	..	23 8 0	..
Ground-moulded country brickwork in clay		12 8 0	..	14 8 0	16 0 0
Platform-moulded brick in chunam		19 0 0	16 8 0	20 0 0	21 8 0
Do. flat arch work in chunam		..	18 0 0	21 0 6	22 8 0
Do. circular or segmental in chunam ..		..	..	21 0 0	22 8 0
Add to above for surki mortar for brick-work		..	..	1 0 0	1 8 0
Add for surki to concrete or rubble		..	1 8 0	1 8 0	2 0 0
Laterite block in course in chunam		..	..	20 6 0	..
Note.—Laterite arch work not to be used.					
Cutstone built into work in chunam		..	..	1 12 0	..
Revetment.					
Rough stone (boulders)		..	..	5 12 0	..
Blasted stone		..	..	9 4 0	..
Laterite blocks, rough		10 0 0	..	9 12 0	..
Do. fine		..	..	14 4 0	..
Laterite rubble		..	..	4 12 0	..
Concrete blocks		18 0 0	..	19 12 0	..
Platform-moulded brick laid dry per 100 c.ft.		..	..	16 0 0	17 5 0
9" brick laid as headers (platform-moulded) per 100 sq. ft. ..		..	..	..	13 0 0
Plastering.					
Plastering with chunam and smoothed over one coat		1 12 0	1 12 0	2 0 0	2 0 0
Do. do. two coats		2 8 0	2 12 0	3 0 0	3 0 0
Do. with Portland cement, ½" thick, 1 cement 2 sand or ¾" thick, 1 cement 3 sand ..		6 0 0	7 9 0	6 12 0	6 12 0
Do. do. ¾" thick, 1 cement 2 sand ..		7 9 0	10 2 0	8 4 0	8 4 0
Do. with surki mortar, one coat		1 14 0	2 0 0	2 4 0	2 4 0
Do. do. two coats		2 14 0	3 4 0	3 4 0	3 4 0
Pointing.					
Pointing walls with chunam (brickwork)		1 8 0	1 11 0	2 8 0	2 8 0
Do. with Portland cement, 1 to 1½		3 8 0	3 9 0	3 8 0	3 8 0
Grouting aprons with surki concrete and surki mortar plaster joints	100 sq. ft.	..	4 0 0	4 0 0	..

Data for Rates exclusive of Lead.

Brick jelly, concrete in lime mortar.

	RS.	A.	P.
One hundred feet brick jelly at Rs. 8-8-0	8	8	0
Twenty-two cubic feet lime (screened) at Rs. 20	4	4	0
Forty-four cubic feet sand at 2 pies	0	7	4
Total material exclusive of conveyance ...	13	3	4
Labour—			
Grinding mortar	1	4	0
Four men at As. 5	1	4	0
Four women at As. 3	0	12	0
Sundries	0	8	0
Total Labour ...	3	12	0
Total, Labour and material ...	16	15	4

or say Rs. 17.

Add for surki Rs. 1-8-0 per unit.

The proportion of lime, surki, sand for surki mortar used with brick jelly is—

Lime.		Surki.		Sand.
1	:	$\frac{1}{2}$	:	2

Rate for table-moulded stock bricks in lime mortar, $9 \times 4\frac{3}{8} \times 2\frac{1}{2}$.

	RS.	A.	P.
One thousand four hundred and fifty bricks at Rs. 10	14	8	0
Twelve cubic feet lime at Rs. 20 per 100 c. ft.	2	3	3
Twenty-four cubic feet sand at 2 pies	0	4	0
Total material...	16	15	3
Labour—			
Grinding mortar	0	10	0
Four bricklayers at As. 12	3	0	0
Two men at As. 5	0	10	0
Three women or boys at As. 3	0	9	0
	4	14	0
Add sundries ...	0	10	0
Total Labour ...	5	8	0
Total ...	22	7	3
or say	22	8	0
Add for surki ...	1	0	0

For platform-moulded bricks $9 \times 4\frac{3}{8} \times 2\frac{1}{4}$.

	RS.	A.	P.
We require 1,500 bricks per unit at Rs. 8	12	0	0

The saving on platform-moulded bricks is about Rs. 2-8-0 per unit.

Block in course laterite in chunam.

	RS.	A.	P.
Laterite in blocks, 100 c. ft.	12	0	0
Twelve cubic feet lime at Rs. 20	2	3	3
Twenty-four cubic feet sand at 2 pies	0	4	0
Total ...	14	7	3
Labour—			
Grinding mortar	0	10	0
Four masons at As. 12	3	0	0
Four coolies at As. 5	1	4	0
Two women at As. 3	0	6	0
	5	4	0
Total ...	19	11	3
Sundries ...	0	10	9
Grand total ...	20	6	0

Revetment or dry flooring.

	RS. A. P.
Labour for laying—	
Rough stone or laterite per 100 c. ft.	2 4 0
Labour for laying concrete block revetment including loss by breaking of blocks in moving	2 12 0
Brick revetment building dry per 100 c. ft.	2 12 0

Rates—Conveyance of material by cart.—The basis of Rs. 1-4-0 per day per cart is taken, the load of a cart being taken as $12\frac{1}{2}$ cubic feet of concrete stone or rough stone.

The bricks required for a unit (100 cubic feet of brickwork) or a unit of brick jelly concrete are taken as lighter than stone in proportion between $\frac{3}{4}$ and $\frac{7}{8}$.

Rates for conveyance of lime taken as $\frac{1}{2}$ those for rough stone. The labour of loading bricks and unloading is more than that of loading and unloading rough stone and a small allowance is made to cover this—

Lead.	Rate for rough stone or concrete stone for one unit work.	Rate for bricks of concrete brick jelly or backing for one unit work.
	RS. A. P.	RS. A. P.
Up to and including $\frac{1}{2}$ mile, 10 trips daily.	0 14 0	0 12 0
Over $\frac{1}{2}$ mile and up to 1 mile, 7 trips ,,	1 8 0	1 4 0
Over 1 mile and up to $1\frac{1}{2}$ miles, 5 trips ,,	2 0 0	1 10 0
Over $1\frac{1}{2}$ miles and up to 2 miles, 4 trips ,,	2 8 0	2 1 0
	For every added $\frac{1}{2}$ mile or part of $\frac{1}{2}$ mile add As. 8.	For every added $\frac{1}{2}$ mile or part of $\frac{1}{2}$ mile add As. 7.
	Rates for conveyance lime (slaked) $\frac{1}{2}$ those in above column.	Rates for surki as in above column.

SECTION XI.

Revenue Aspects of the Project with Notes on Crops now grown and Roads and Railways in the Tract to be irrigated.

276. *Revenue aspects of the Project.*—The Revenue aspects of this project and the rate of development of irrigation are dealt with by the Revenue Department in the Reports of the Special Revenue officer (Mr. Wallace) and the Proceedings of the Board of Revenue and the Government Order in the Revenue Department. These are printed as Appendix II of this volume.

The general conclusions arrived at are briefly noted here.

277. *Gross area commanded and net area to be irrigated.*—The gross area commanded by the Project which includes small uncommanded plots entirely surrounded by commanded lands is 542,864 acres.

This area is made up as below :—

	Total commanded area.	Area to be irrigated under the Project channels.
	ACS.	ACS.
Government	190,262	132,631
Zamindari	85,983	55,000
Inam	252,240	148,404
Pudukottai State	14,377	8,600
Total ...	542,864	344,635

Of this irrigated area, 16,240 acres is existing irrigation under the Delta channels to be supplied by the new system, most of the area being under the existing Vadavar.

In addition to the above there are in the total commanded area scattered patches of existing wet cultivation under tanks whose supply is somewhat precarious.

278. *Areas excluded for special reasons from irrigation.*—The following areas have been excluded from irrigation in Government villages commanded for the specific purposes noted :—

Purpose to which assigned.	Area.
	ACS.
Existing village-sites	3,128
Extension of village-site and dry tract round each village ...	13,007
Roads and railways	2,971
River channels or drainages	6,362
Forest	3,699
Existing tank-beds	21,179

In other commanded villages the total of unirrigated area in comparison to area to be irrigated is larger than in Government villages, and it may from this be assumed that in these sufficient unirrigated area is available for such purposes.

279. *Rate of development of irrigation.*—There will according to the construction programme be no effective capacity impounded in the Cauvery reservoir for irrigation purposes until the sixth year of construction.

The development of irrigation is expected to commence in that year with the irrigation of 15,000 acres single crop under the Vadavar system which will be extended in the seventh year by another 15,000 acres. After this year an increase in new irrigated area of 50,000 acres yearly is expected by the Revenue officers until the whole new area is taken under wet cultivation by the project channels.

It is expected that the whole new area will have been taken up by the eighth year from commencement of extension of wet cultivation, that is, the thirteenth year after commencement of Project construction.

For the double crop in the existing delta it is expected that no extension will take place till the eighth year of construction.

By this time it is believed the ryots under the existing system will have realized the significance of the improved supplies due to the reservoir and will commence to extend the double cropped area.

The new area is forecasted to commence double cropping in the ninth year of construction with an area of 15,000 acres. Extension of double crop area at 15,000 acres per year is anticipated in the delta and at the same rate in the new area in subsequent years till the full areas 70,000 acres in the existing delta and 75,000 acres in the new area is realized.

280. *Forecasted rate of revenue.*—The rates of revenue per acre to be expected from the new area is approximately Rs. 6 per acre for a single crop and Rs. 4 per acre for a second crop.

In the delta the revenue forecast anticipates, owing to the improved supplies given by the reservoir, the raising of lands classed as class II to class I and class III to class II at the next settlement 1922–23. The revenue statement takes credit for such raising.

281. *Maintenance charges.*—The deductions from gross revenue for "working expenses" is assessed at 13½ annas yearly per acre of new area irrigated.

The actual "working expenses" of "direct irrigation" systems in this Presidency has been in the past about 8 annas per acre.

The upward trend of rates and the continually increasing difficulty with labour have made it desirable to increase this rate to As. 9–6.

To this is added 4 annas per acre for the upkeep of the head works which totals to a yearly sum Rs. 82,000.

The "Revenue Management" charges are assessed under the rules in force for such services in this Presidency.

While these latter rates appear open to the charge of being greatly in excess of requirements in the case of a large system this is not the place in which such a question can be discussed.

282. *Preliminary and Investigation Expenses.*—The expenses incurred in the surveys, investigations and preparation of this estimate and in addition the cost of the preparation of the previous project and estimate by Mr. H. A. Moss are divided up between the main heads of this estimate and covered by the provisions of the estimate under the sub-head (A) Preliminary Expenses.

The investigation cost is estimated as under :—

	RS.
Cost of Mr. Moss' investigation ...	96,376
Sanctioned estimate for the present re-investigation, Cauvery Project ...	1,70,100
One-third cost of Special Superintending Engineer's establishment ...	25,600
Total ...	2,92,076

In addition there will be further "Preliminary expenses" to be incurred after the sanction of the estimate which are provided for by a lump sum of ½ lakh for the head works and an allowance at mileage rates for main canals, branches and distributaries as below :—

	Per mile. RS.
Main canal ...	100
Branch canals ...	60
Major distributaries ...	40
Minor distributaries ...	10

The expenditure to be incurred prior to sanction of the estimate Rs. 2,92,076 has been allocated to main heads of works as under :—

	RS.
I. Head works ...	1,00,000
II. Main canals and branches ...	75,000
III. Distributaries ...	1,17,076
	2,92,076

283. *Establishment Charges.*—The estimate provides for the cost of the Public Works Department establishment to be employed on the works under the rules in force at 23 per cent on the cost of "works" excluding the item (A) Preliminary expenses and (B) Land, and the cost of steel sluice shutters and gear to be procured from England on which latter item 10 per cent for "Establishment" is allowed.

In addition to this, the estimated cost of salaries (and leave and pension allowance) of officers of other departments whose services will be required is separately provided for. The total sums provided for as above are enormously greater than the cost of establishment could possibly amount to as will be seen if the cost of the establishments proposed in the next section of this report is totalled up but this excessive allowance is made in accordance with the rules and orders on the subject.

284. *Suspense.*—Allowances have been made for losses by damage to stores and by disposing of surplus "Stock" on completion of the project under the head "Suspense".

285. *Receipts on Capital Account.*—Under this head credit is taken for realizations during construction by the sale and rent of buildings and by sale of tools and plant as the works approach completion.

This last item is likely to be considerable.

Indirect Charges.

286. *Leave and Pension Allowances.*—This is provided for at 14 per cent on cost of "Establishment".

287. *Abatement of Land Revenue.*—This is capitalised on the estimate of annual loss of land revenue at 25 years' purchase.

For the *Head Works* the figures of the Special Revenue Officer as given in his report are incorporated in the estimate.

For the canal and distributary system, the rates recommended by Mr. Wallace are adhered to but revised areas arrived at subsequent to the date of Mr. Wallace's report from the actual measurements and computation of requirements are used in computing the totals.

The rates of assessment of annual loss of land revenue recommended by Mr. Wallace were—

Lands west of Tanjore.

	Per acre. RS.	A.	P.
Wet land ...	10	0	0
Dry ,, ...	1	8	0
Other lands.			
Tanjore taluk ...	1	0	0
Pattukkóttai ...	0	14	0

For Mannārgudi taluk the same dry rate as for Tanjore is taken, while all wet lands are allowed for at Rs. 10 per acre.

Areas occupied.—The actual areas to be occupied by the distribution system as worked out are—

—	Main canals and branches.	Vadavar distributaries.	Total.
	ACS.	ACS.	ACS.
Wet land ..	746·9	22	768·9
Dry land west of Tanjore ..	735·5		735·5
Dry land east and south Tanjore (Tanjore or Mannārgudi) ..	1,860·3	640	2,500·3
Total ..	3,342·7	662	4,004·7

The assessment of abatement of land revenue on the above is worked out below:—

	RS.
Wet land, $768{\cdot}9 \times 10$ ...	7,689·0
Dry land, $735{\cdot}5 \times 1\frac{1}{2}$ west of Tanjore ...	1,103·2
Dry land, Tanjore or Mannārgudi $1{,}070{\cdot}1 \times 1$ ...	1,070·1
Do. Pattukkottai $1{,}430{\cdot}2 \times \frac{14}{16}$ ...	1,151·4
	11,113·7
Say Rs.	11,114·0

Grand Anicut Canal Distributaries—Abatement of land revenue.—For the "Distributaries" Grand Anicut Canal the abatement of land revenue is computed from the data obtained from the Vadavar system distributaries allowing the same rate per acre irrigated.

The abatement of land revenue, Vadavar system, is—

		RS.
	640 acres, dry at Re. 1	640
	22 „ wet „ Rs. 10	220
Total ...	662 „	860

The annual revenue lost on Grand Anicut Canal Distributaries is $\frac{2,72,463}{34,911} \times 860$ = Rs. 6,712.

Total loss under the system.

	RS.
Head works	2,22,500
Main canals and branches and distributaries 17,826 × 25 ...	4,45,650
Total ...	6,68,150

288. *Communications in the area to be irrigated.*—The map of the irrigated area shows the existing railways and main roads and the more important cart-tracks.

It will be seen that both the new and the existing areas are well served by railways, and outlets to the sea at Negapatam and Adirampatam are in convenient proximity.

From the latter place there is already a large sea export traffic of produce in sailing boats to Colombo and other places in Ceylon.

This traffic may be expected to expand.

The existing roads are not good but the absence of road metal makes good roads very expensive to make and upkeep. The nature of the soil however facilitates cart-traffic over tracks as it does not become slushy in wet places.

There are a large number of recognized cart-tracks and all these are to be reserved for purposes of communications.

The area registered as poramboke for roads, railways, cart-tracks in the area of Government villages commanded (from Statement B, Revenue officer's report) is 2,970 acres and this does not include the greater part of the area of Pattukkōttai taluk which is a zamindari or inam land.

Bridges have been very liberally provided for in the estimates on all existing lines of communication.

Most of the bridges are for wheeled traffic but five foot bridges have been provided for.

Under main canals and branches bridges are proposed as follows :—

Grand Anicut system.

Main canal	One bridge to every $1\frac{3}{4}$ mile length.
Branch canals	One bridge for every 2 miles.

Vadavar system.

Main canals and branches ...	One bridge to every $1\frac{3}{4}$ miles.
Distributaries	One bridge for every $1\frac{1}{4}$ miles.

Under the "Distributaries" most of the "drops" are "syphon drops" which type of work combines a bridge and drop.

In addition to existing roads and cart-tracks the banks of main and branch canals are of sufficient width to allow of them being made into roads where required.

289. *Crops now grown in area to be irrigated.*—The Special Revenue officer gives a table of the most important crops now grown in the Tanjore district (Return R) and notes on this subject briefly in paragraphs 92 and 93 of his report (Appendix II).

SECTION XII.

Programme of Execution of Canal System.

290. *Rate of proposed development of distribution works*.—The year of commencing new irrigation and the rates of expansion of irrigation have been stated in the last section.

It is proposed to commence extension in the new areas under the Vadavar system and the first year new irrigation will be confined to this system.

The general policy of the construction programme is to construct the system of canals and distributaries at such a rate that at the end of each year distributary channels can deliver water to a new area double that to be newly irrigated in the next year under the programme.

Thus the distribution works must be capable of supplying 60,000 acres at the end of the sixth year and an additional 100,000 acres each subsequent year. At this rate of progress water can be given to any part of the area from after the end of the ninth year of construction.

291. *Programme, Vadavar System.*—The new area under the Vadavar system is 43,091 acres and the estimated cost of construction for "Works" exclusive of "Land" about 7¾ lakhs, and this will be commenced in the third and completed at the end of the fifth year.

292. *Programme, Grand Anicut System.*—The areas under the Grand Anicut canal taken by sections from the head inclusive of all off-takes with approximate cost of construction for "Works" exclusive of "Land" are stated below:—

Grand Anicut Canal system.

From Head to R.D. 16/0000 at off-take of Kalianodai Branch and inclusive of this branch and Vadakadu Branch.	Rs. 43½ lakhs, 120,000 acres must be complete at end of seventh year.
From Head to Ambiliar R.D. 37/8300 including Rajamadam Branch.	Rs. 75 lakhs, 220,000 acres must be complete at end of eighth year.
From Head to tail inclusive of whole system.	Rs. 83 lakhs, 285,000 acres must be complete at end of ninth year.

From the above, it will be seen averaging out yearly expense on works that this is highest for such a programme at the end of the eighth year, and the programme of construction has for its objective a reasonable distribution and arrangement of expenditure and establishment to complete the system down to the Ambiliar in that period.

The commencement of new irrigation is forecasted for the sixth year and a large area (over 50,000 acres) is only realized in the eighth year.

293. *Remarks on the incidence of cost of the programme proposed.*—The extension of irrigation connotes a great demand for field labour for preparing fields, transplanting and harvesting and it is desirable to arrange the construction programme having this in view and arrange the heaviest expenditure on works before this demand has become very great. This has been done.

It may be noted that this procedure involves greater cost in the form of interest on capital than if construction were kept back and greater expenditure in the later years provided for. Such a programme would show a better result on paper but would probably result in practice in delaying development of irrigation and in causing undue inflation of rates.

The programme therefore allows for breaking the back of the work before the great demand for field labour arises. The whole area to be supplied must be covered with distributary channels by the end of the ninth year, so that from these water can be given to any plot in the area.

This, however, does not imply that the works will be absolutely complete by this time.

There will be in the area many small incomplete works especially, pipe sluices, which must be carried out before the works as estimated for are complete. Establishments are maintained and expenditure is therefore continued till the eleventh year, and it is not proposed that all the works shall be administered as a single crop executive division to the twelfth year.

Although the expenditure on "Capital" in the tenth and eleventh years will be small, the work will be very numerous works of a petty but very important nature and such as require numerous establishment for its supervision.

These remarks will make clear the provisions made for organization of establishment dealt with in the next section.

Work on the Grand Anicut canal system will be commenced the first year of project construction.

294. *Land acquisition for the canal system.*—The estimated provision for land acquisition amounts to a large sum made up as noted below :—

Grand Anicut system.

	RS.
Main canal and branches	5,49,900
Distributaries	13,02,800
Total ...	18,52,700

Vadavar system.

	RS.
Main canals and branches	78,100
Distributaries	2,10,180
Total ...	2,88,280
Grand total ...	21,40,980

Although considerable extents of this land will not be required to be occupied for works for several years after starting works, it will be desirable to acquire all lands required as soon after the sanction of the project as they can be located as rapid rise in prices of land is sure to take place on the commencement of construction.

It will doubtless be possible to arrange to leave lands in temporary occupation of cultivators until actually required for works, and the charge for abatement of land revenue will not therefore be more fairly distributed over the period of construction than the cost of land acquisition.

The programme therefore proposes acquiring a large proportion of all the lands required in the first three years of construction.

In the first year much time will be taken up in preliminary enquiries, and one lakh only is allowed for actual payments in this year.

From the total estimate for land 20 per cent is deducted and provision made for spending the balance on land in the first three years spreading the rest of the estimated expenditure over the remaining years.

Thus expenditure on land is provided for as under :—

	RS.
First year	1,00,000
Second year	8,06,392
Third year...	8,06,392
Fourth to ninth year	4,28,196
Total ...	21,40,980

295. *Revenue establishment for land acquisition.*—Provision for revenue establishment for land purposes is made as under:—

	Years.	Monthly.
		RS.
One Divisional Officer	3	1,000
One Deputy Collector	3	400
Do.	9	400
Subordinate officials and office establishments	3	1,000
Do. do.	6	25
Total cost ...		1,47,600

It may be considered whether such establishments from other departments should not be debited against the general provision for "Establishment" at a centage rate on cost of works made in the estimate. As no order on the subject permits this, provision for such establishment is made.

296. *Special Survey Party for localising lands.*—The localisation and marking out of land to be acquired on the canals and distributaries already located on the ground will require a Public Works Department staff working in co-operation with the Revenue.

Further, the localisation on the ground of the "Distributaries" Grand Anicut Canal system has still to be done although the block maps already prepared has enabled approximate location to be fixed for the larger channels, and provision is made for this as described in next section for a special Survey Party for two years.

It will be desirable to appoint this party and get it to work some months before the first year of construction.

This would form a charge against "Preliminary Expenses".

Cauvery Reservoir Project—Canal system—Yearly distribution of expenditure.

Main heads.	Year and expenditure in thousands of rupees to the nearest thousand.											Total.
	1	2	3	4	5	6	7	8	9	10	11	
Works, Ordinary	4,00	8,00	13,00	14,22	14,50	11,00	9,00	7,00	6,00	3,30	2,53	92,55
Do. Land	1,00	8,06	8,06	71	72	72	71	72	71	..	..	21·41
A. Direct Charges.												
I. Works	5,00	16,06	21,06	14,93	15,22	11,72	9,71	7,72	6,71	3,30	2,53	1,13,96
II. Establishment	80	2,06	3,32	3,35	3,41	2,61	2,15	1,69	1,45	76	58	22,18
III. Tools and plant	13	46	44	31	32	26	14	11	9	5	4	2,35
IV. Suspense	20	20	40	20	— 10	— 10	— 10	— 6	— 4	— 10	— 20	30
V. Receipts on capital account.	— 1	— 4	— 4	— 3	— 2	— 2	— 2	— 3	— 2	— 9	— 18	— 50
Total, A. Direct Charges ..	6,12	18,74	25,18	18,76	18,83	14,47	11,88	9,43	8,19	3,92	2,77	1,38,29
B. Indirect Charges.												
Capitalized abatement of Land Revenue	21	1,67	1,68	15	15	15	15	15	15	..	..	4,46
Leave and pension allowances ..	11	29	47	47	47	37	30	23	21	10	8	3,10
Total, B. Indirect Charges ..	32	1,96	2,15	62	62	52	45	38	36	10	8	7,56
Grand Total ..	6,44	20,70	27,33	19,38	19,45	14,99	12,33	9,81	8,55	4,02	2,85	1,45,85

SECTION XIII.

General Organization for Execution of Works.

297. *Engineer-in-Chief.*—It is proposed that the whole of the Project works will be under the control of an Engineer-in-Chief who will be an administrative officer.

It is considered that after the end of the eighth year of construction this officer will be no longer required.

Further, this officer should have one year to study his schemes and arrangements and make working plans before construction commences, making a total period of employment of nine years.

298. *Superintendents of Works.*—Under the Engineer-in-Chief the works will be divided into two charges—

(1) Head Works.

(2) Distribution System.

Each will be under a Superintendent of Works who will be a senior Executive Engineer with other Executive Engineers working under him.

These officers will be Executive officers with powers of Superintending Engineers and each will have a personal assistant to superintend drawing office work.

299. *Organization of charges, Head works.*—For the Head works there will be only one main accounts office under the Superintendent of Works.

The attached diagram shows clearly the system or organization and distribution of duties proposed.

After the eighth year of construction, the Superintendent of Works to hold independent charge of the head works till the end of the eleventh year, when the works will be transferred to the charge of whatever circle of superintendence they are to permanently belong to.

300. *Superintendent of Works, Distribution system.*—The organization of the staff on this into separate divisions is shown in the diagram.

The Superintendent of Works will superintend and arrange for all works, and working drawings, for acquisition of land, and location and design of the distributary system.

301. *Survey Party.*—A survey party of one junior Executive Engineer with a staff of four Upper Subordinates at his disposal is provided for the first two years in connection with the acquisition of lands and with the alignment and design of distributaries, Grand Anicut system.

302. *Vadavar division.*—In the third year this party may conveniently form the staff for the Vadavar Division which will be a small division with the task of carrying out the Vadavar system works (third to fifth year) and all works east of the Kannanar.

This division might conveniently work without a separate independent office or separate complete divisional organization as the accounts of these works could be kept by the Tanjore division.

303. *Tanjore division.*—The Tanjore division with headquarters at Tanjore should be formed the first year and will be the chief record office.

This division will, to start with, have as limits the following :—

Main canal to boundary of Tanjore taluk.

Distributary system.—All to west and north of Tanjore and north of South Indian Railway, Negapatam Branch, or Main line.

All south of Tanjore and in the Tanjore taluk west of the Kannanar excluding the Kalianodai branch, below the bifurcation of the Vadakadu branch with all connected channels.

304. *Pattukkottai division.*—Pattukkottai division with headquarters, Pattukkottai will be formed the second year and will undertake all the works in Pattukkottai taluk and elsewhere on the west side of the Kannanar and not allocated to the Tanjore division.

As channels and blocks are complete and come into operation they will be transferred from Pattukkottai division to the Tanjore division which will gradually, as works get further south, become a maintenance and water distribution division.

At the end of the eleventh year all works will be transferred to Tanjore division.

When the works are complete, Tanjore division will have charge of them and will form a permanent addition to the divisional charges in the Madras Presidency.

305. *Transfer of works to permanent circle of superintendence.*—A special Superintendent of Works will not be required after the end of the ninth year when the works can be transferred to whatever ordinary circle of superintendence they are to be included in.

SECTION XIV.

Acknowledgment of Assistance and Services.

306. *Work of Mr. H. A. Moss.*—In drawing up this project, frequent reference has been made to the previous Cauvery Reservoir Project by the late Mr. H. A. Moss, Executive Engineer, Public Works Department, and the work of that officer has been made use of wherever possible.

The account of previous proposals and description of the system of wet cultivation practices in the Tanjore delta has been taken with few alterations from that officer's report.

The investigations regarding this project include the valuable work by many Officers and Upper Subordinates, but mention is only here made of the work done by a few officers in the later and more clearly defined stage of investigation.

307. *Field work and officers in charge.*—This later stage of investigation was organized as follows:—

The "field work" was divided into two sections—

(1) The Upper section under Mr. Allen Campbell as Executive Engineer.

The work of this section comprised the Velocity and Silt Observations, the Surveys for Head Works and Reservoir water-spread and to this was added in February 1910 the location and survey of the Grand Anicut Canal from the head to the exit from Tanjore town.

Mr. Campbell showed great aptitude for location and he was the first to draw attention to the superior advantages of the actual site selected for the reservoir dam.

(2) *The Lower section.*—This comprised the detailed survey and levelling over the area to be irrigated and survey of possible alternatives in location of canal and channel alignments.

Charge of this work has been held by several officers, but the bulk of the work has devolved on Mr. W. P. Clay (Temporary Sub-Engineer) who has been employed on it continuously throughout the investigation and has been for more than half the time in immediate charge and in the intervals has worked as first assistant of this section

The work has involved strenuous and sustained exertions and the services of Mr. Clay have been meritorious.

308. *Design of distribution works.*—The work of detailed design of the distribution system and preparing estimates for the same has been in charge of Mr. L. D. Venkatarama Ayyar, B.A., B.C.E., Executive Engineer, and his work included final location of the main canal below Tanjore.

Mr. L. D. Venkatarama Ayyar has organised his Drawing office and staff and has carried out the very important work entrusted to him in a thoroughly efficient manner.

309. *Assistants working in office of Superintending Engineer.*—Mr. R. A. Ryves, A.M.I.C.E. (Temporary Engineer, Public Works Department), made a special study of masonry dams and drew up a valuable note on the subject.

The considerations brought forward in this note have formed the basis of design of the reservoir dam profile. Mr. Ryves assisted in the preparation of the designs of types generally adopted on distribution works and especially in working out the "Syphon Well" type of drop.

Mention is further made of the services of Mr. P. A. Venkatarama Ayyar, B.C.E., Supervisor, who has done good work as head of the Drawing office of the Superintending Engineer and of Mr. T. R. Narasimhachari, B.A., B.C.E. (Overseer), who has made all the stress and stability calculations for the profile of the main dam as well as for many of the types in Mr. Ryves' note and has acquired great proficiency in this class of work.

310. *Directions for general scope of the Project.*—The general scope of the works proposed have been the subject of consideration by the Inspector-General of Irrigation, Mr. J. Benton, C.I.E., and the Chief Engineer for Irrigation the Hon'ble Mr. C. A. Smith, while the general arrangements of design have been made the subject of constant reference to the last-named officer whose instructions have been freely sought and given throughout the investigation.

W. M. Ellis (Bt.), Colonel, R.E.,
Superintending Engineer.

15*th October* 1910.

PART II.

NOTE BY THE CHIEF ENGINEER FOR IRRIGATION.

PART II.

Note by the Chief Engineer for Irrigation, dated 31st October 1910.

A.—General.

The Cauvery project as now prepared provides for a reservoir at Metur with an effective capacity of 80,000 m.c.ft., a new canal taking off from the Cauvery at the Grand Anicut to irrigate 333,753 acres in Tanjore and Pattukottai taluks of Tanjore district, and an extension of the existing Vadavar channel, a branch of the Vennar, to irrigate a total area of 57,950 acres. The Special Superintending Engineer's report describes the project in great detail and, as his proposals have my entire approval, it is unnecessary for me to do more than note as briefly as possible upon the more important points, and especially those upon which there is any probability of a difference of opinion.

2. The great difficulty in all storage projects is to make them productive, and this can generally be most conveniently arranged by providing for as large an area as possible of new irrigation. In the present case the problem has been complicated by what has been along recognized as the principal object of the project, i.e., the necessity of not only safeguarding the interests of, but also improving the supply to, the existing Cauvery delta.

It is claimed for the project now under consideration that this has been fully provided for, but it must be recognized that in order to do this the capacity of the reservoir has been increased to a considerable extent over and above that which would have been necessary if the interests of new irrigation only had been considered.

3. *Effect upon present delta.*—The only direct return to be credited to the project for this additional expenditure is that to be realized from the change of classification of II and III classes delta and land to I and II classes respectively. The additional expenditure is approximately estimated at Rs. 75,00,000, which is the difference of cost between a reservoir with an effective capacity of 40,000 m.c.ft. which would amply suffice for the new irrigation only and that with a capacity of 80,000 m.c.ft. now provided for and the additional net revenue to be realized from the extra expenditure is Rs. 5,97,450, which is made up as follows :—

	RS.
Amount realizable from existing delta as shown in paragraph 11 of G.O. No. 3347, Revenue, dated 15th October 1910, is ...	6,28,894
Deduct 5 per cent for collection charges	31,444
Total net revenue ...	5,97,450

The above increase in revenue will not come in till the resettlement in 1923–24, and there will be some accumulation of interest to add to the extra capital cost. Allowing for this, say, Rs. 3,00,000 per annum for five years = Rs. 15,00,000, the total extra cost will be Rs. 90,00,000. The net revenue as calculated as above will give a percentage of 6·64 per cent against 6·9 per cent for the whole project. It is considered that this return may under the particular circumstances of the case be accepted as reasonable and sufficient.

The above conclusion as to the increase of revenue from the delta for which the project may take credit, has been arrived at after full consideration by the Revenue officers and accepted by Government.

I will, therefore, only remark that as the delta irrigation runs absolutely no risk of any loss by the new project, while the conversion of the present intermittent supply into a continuous one cannot but be a distinct advantage to all, there can be no grounds whatever for the Tanjore landholders to object to the project. In this connexion, attention is invited to paragraphs 53—55 of the Special Superintending Engineer's report, in which the effect of the project in bad years upon the existing delta is described.

4. *Scope of the project.*—In accordance with the above principles and for the reasons given in paragraphs 44 *et. seq.* of the Special Superintending Engineer's report, the present Grand Anicut scheme was finally selected and worked out, and

it may be stated here that if, as is anticipated, it is found hereafter that there is sufficient water, it will probably be found practicable to take up the Bhavani project which is briefly described in paragraph 46 of the report.

This possibility was foreseen when considering the respective merits of the Kattalai and Grand Anicut schemes and it was considered the other things being equal, the Grand Anicut scheme followed by the Bhavani would be preferable to the Kattalai scheme without the Bhavani project.

It is not however proposed to take up the Bhavani project until experience of the working of the Cauvery project has proved that there is sufficient water available for it and it need not, therefore, be referred to again at present.

5. *Programme of construction.*—This has been described in detail by the Special Superintending Engineer in paragraph 128 *et seq.* of his report, but I desire to draw very special attention to the following points.

It will be seen from paragraph 128 of the report that the quantity of masonry to be built is very large indeed, and the attainment of the estimated rate of progress will depend entirely upon the adequacy of the various arrangements, especially those for transport and labour-saving machinery. The amount of both skilled and unskilled labour required will in any case be very large and it is very desirable to reduce the latter as much as possible.

The whole of these arrangements will have to be very carefully thought out beforehand and everything brought into complete working order before any attempt is made to commence construction work upon a large scale. For these reasons, I am strongly of opinion that the one year allowed by the Special Superintending Engineer as described in paragraph 133 of his report for further consideration and elaboration of proposals by the Engineer-in-Chief before actually commencing construction work is a very necessary provision. It will also be seen from paragraphs 130 and 132 that a further period of two years is allowed for "preparatory works" before any commencement is made with the actual construction of the masonry of the dam.

Although the work to be done in these two years is described as "preparatory", it really involves a considerable amount of expenditure, and includes the very important work of preparation of the foundation of the main dam in the river-bed. It may of course be found possible in these two years to do a certain amount of masonry on the dam elsewhere than in the river-bed, but it is expected that the masonry work will be chiefly confined to the subsidiary works. The desirability of this course lies not only in the necessity for careful elaboration of the supply and transport arrangements, but also for keeping the excavation and preparation of the foundation of the dam well in advance of the building work. This necessity was very fully realized during the construction of the Periyar dam and I had similar experience myself on a smaller scale at the Kodayar dam in Travancore.

I am strongly of opinion that the whole of the excavation of the foundation trench down to sound rock should be taken out before any masonry is commenced in the river-bed, but after this is done the arrangements proposed by the Superintending Engineer in paragraph 116 for building the work in sections may be adopted.

I am confident that if good use is made of the above period, the apparent delay will be saved over and over again by the subsequent steady progress which will be ensured by it.

6. For similar reasons, I strongly recommend that the officer who is elected to fill the place of Engineer-in-Chief should be specially deputed to visit works under construction and those of the chief manufacturing firms in England and elsewhere to collect information as to the latest and best labour-saving machinery and conveying plant.

I would recommend that this be done as soon as the Government of India have satisfied themselves as to the soundness of the project and have sent it on to the Secretary of State. I recommend that the officer selected should be given a free hand to decide what works and manufactories to visit and that he should be granted a sufficient sum in advance to enable him to travel entirely free of expense to himself.

The cost of this deputation will be insignificant compared with that of the project, but its results will be far-reaching both as regards saving of time and cost of construction. Not only does the latter depend largely upon the former but so also does the growth of revenue due to the project.

7. *Proposed construction staff.*—As regards the staff proposed for the construction as described in section XIII, paragraphs 297–305 of Superintending Engineer's report, I again draw particular attention to the magnitude of the work.

The staff proposed may at first sight appear large, but in a country like India where the success of all engineering construction depends so very largely upon adequate supervision, it would, in my opinion, be very bad policy to attempt to economize under the head of "Establishment".

The amount provided under this head is far more than the cost of the staff proposed and I therefore strongly recommend the adoption of the proposals made which, I may here state, have been made by the Special Superintending Engineer after personal consultation with myself and also with another senior officer who was employed for some time on the Periyar dam and in whose opinion I have much confidence.

It will be seen that provision has been made under Establishment for Special Revenue Officers for taking up the land required and also a Special Forest officer to be in charge of the operations connected with the supply of firewood for the head works. The quantity of firewood required is very large, being about 1,70,000 tons estimated to cost Rs. 17,00,000 and as so much depends upon the regular supply, it is considered necessary to arrange for adequate supervision of the operations. This officer should be posted to the work as soon as the estimate is sanctioned. The necessity for the Medical staff provided is obvious and requires no explanation.

8. *Revenue forecast.*—As regards the revenue forecast, I should like to express here my satisfaction that the Revenue officers have after full consideration arrived at the conclusion that it is not only possible but reasonable to consider the question of water rates not only upon the actuals realized in the past, but also upon future probabilities. The Public Works Department is obliged to apply this principle to their rates of cost when preparing their project estimates and it is obvious that with rates of cost when preparing their project estimates and it is obvious that with rates for materials and labour steadily rising, further projects will soon be quite impracticable unless the revenue returns increase proportionately. The adoption of the principle will therefore make a great difference to future proposals for extension of irrigation and will probably enable other projects to be undertaken, which have hitherto been considered impracticable on account of the poor financial results anticipated.

The rate of development of the new irrigation has been fixed by the Special Revenue officer and accepted by Government in the Revenue Department and it will be seen from Superintending Engineer's paragraphs 290–293 that the programme of execution of the distribution system has been carefully considered and adequate arrangements made to provide for the extension of irrigation at the rate anticipated.

9. *Land acquisition.*—Attention is invited to the proposals of the Superintending Engineer in paragraphs 294 and 295 regarding the acquisition of the land. These proposals are considered to be suitable and may be accepted.

10. *Rates.*—This question has been dealt with in full detail by the Superintending Engineer in section IV, paragraphs 122–127 of his report, as regards head works and section X, paragraphs 261–275, as regards the Main canal and distributaries.

The general principles followed in preparing the estimates for the project have been to provide rates which are considered to be sufficient to commence the work and carry it on for some time. To provide for the possible further rise in rates liberal provisions have been made in the shape of lump sums for unforeseen works which, however, will not be drawn upon without due authority. The total provisions in the project have been carefully worked out, and endeavours made to foresee and provide for all possible requirements, and the amounts finally provided are considered to be sufficient to complete the works.

11. *Financial.*—The total cost of the project is as detailed below :—

		RS.
(1) Head works	...	1,71,24,000
(2) Main canal and branches	...	71,32,000
(3) Distributaries	...	42,63 972
Total works	...	2,85,19,972
Establishment	...	62,22,283
Tools and plant	...	25,40,535
Suspense	...	80,000
Deduct—Receipts on Capital account	...	— 4,02,060
Total direct charges	...	3,69,60,730

	RS.	
Abatement of land revenue	6,68,150	
Leave and pension allowances	8,71,120	
Total indirect charges	...	15,39,270
Grand total	...	3,85,00,000

The forecast of expenditure is as shown in the table A attached to this note. The growth of revenue has been taken from the table accompanying G.O. No. 3347, Revenue, dated 15th October 1910. The financial tables Parts I to IV have been prepared in accordance with the above and on the lines laid down in Public Works Department Code, paragraphs 738 and 1889.

From table No. IV it will be seen that the result attained ten years after completion of the works is that there is after deducting indirect charges an accumulated surplus of net revenue over interest charges of Rs. 66,81,759.

The project therefore amply fulfils the conditions of a productive work with a good margin of safety and it may therefore be safely recommended for sanction.

12. In conclusion, I wish to record my opinion that great credit is due to Colonel W. M. Ellis, R.E., and his staff for the very able, careful and complete manner in which they have worked out the details of this project.

I can personally testify that every possible precaution has been taken by Colonel Ellis and neither time nor trouble spared to ensure reliable results and I can confidently recommend this project for sanction as being a thoroughly sound one in all respects not only as regards its engineering features, but also as regards its estimate of cost.

B.—Technical.

Section II of the Superintending Engineer's Report—Scope of the Project and Details of Water Supplies.

13. The lines upon which working tables of the reservoir have been prepared and the duties adopted for both new and old irrigation have been carefully considered in the light of past experience and may be accepted as reasonable and sufficient.

Section III of the Superintending Engineer's Report—Reservoir and Head Works.

14. *Superintending Engineer's paragraph* 65—*Allowance for silt deposit.*—It may be admitted that the allowance is based to some extent upon assumptions, but it is considered that these assumptions allow sufficient margin of safety and are justifiable. The possible effect of the silt deposit upon the effective capacity of the reservoir is dealt with in greater detail in the Superintending Engineer's paragraph 121. It is difficult to estimate the exact rate at which the efficient capacity of the reservoir will be reduced, but on the whole the Superintending Engineer's conclusion seems to be reasonable and may, it is considered, be accepted.

15. *Superintending Engineer's paragraph* 74.—The Superintending Engineer describes in detail how the flood discharge to be provided for has been arrived at and it is considered that his conclusions are safe and may be accepted, more especially as the proposed arrangements for disposing of the surplus allow a considerable margin of safety.

16. *Superintending Engineer's paragraphs* 90—99.—The design finally adopted for the section of the main dam has been arrived at after a considerable amount of study of the general principles for designing dams and it is considered that the design, which is in accordance with the latest available knowledge on the subject, may be safely accepted.

17. *Superintending Engineer's paragraphs* 100--108.—The necessity for providing for the possibility of temperature-cracks is, it is considered, fully established.

It is doubtful whether it will be possible to entirely prevent the occurrence of such cracks and it is therefore very advisable to locate them in suitable positions as proposed by the Special Superintending Engineer so as to minimize their effect as much as possible and render them innocuous. As regards the exact form of temperature-joint to be adopted, it is considered that information as to the design of the joints finally adopted for the Olive Bridge Dam and the results will probably be available in time to enable use to be made of such information when constructing the Cauvery dam. For the present, the Superintending Engineer's proposals may be provisionally accepted.

18. *Superintending Engineer's paragraphs* 104--105.--I myself am of opinion that it is likely to be found convenient in practice to make considerable use of concrete partly because I believe that it can be executed more rapidly, and partly because it enables more machinery to be used and labour thereby saved.

At the same time, I think that good rubble work is superior to concrete and should, if possible, be used.

As however the design and estimate will admit of the use of either rubble masonry or concrete, it may be left to the officer in charge during construction to adopt whichever material he finds most convenient, subject to the proviso that rubble work only is used in the lower part of the high portions of the dam where the stresses are greatest.

19. *Superintending Engineer's paragraphs* 111-112.--The types of sluice proposed and the estimate of cost have been settled by the Superintending Engineer in correspondence with Messrs. Ransomes and Rapier and may be accepted.

20. *Superintending Engineer's paragraphs* 116--120.--The proposed arrangements for construction may be provisionally accepted as a reasonable and practicable forecast subject of course to such modifications as the officer in charge finds desirable after further consideration.

21. *Superintending Engineer's paragraps* 122--127.—It may safely be concluded that suitable materials for the masonry of the main dam are available within reasonable distances and that the rates provided are sufficient.

22. *Superintending Engineer's paragraphs* 128—139.—The proposals for distribution of expenditure have been carefully worked out and may be accepted.

23. *Grand Anicut System—Main Canal.*--I have been over on the ground the final line for the first 40 miles and have also seen the country through which the rest of the main canal and the principal distributaries are now laid out. I consider that the line is the best available and that the grading and the arrangements proposed for passing the cross drainages are generally suitable.

It will be seen from the Superintending Engineer's report that the effect of the main canal upon the existing irrigation under tanks has been carefully thought out and arrangements considered most suitable made.

24. *Designs of masonry works.*—Complete designs have been made for all cross drainage works. These are considered to be generally suitable and adequate for the purposes of the estimate. Some slight modifications will no doubt be found necessary when preparing the final working plans and with the exception of the few following remarks I do not propose to note on the designs in detail.

G. 4 ², Head Regulator.—It is only necessary to mention that the presumed M.F.L. of 202·41 marked on the plan is that which was used when designing the Cauvery and Vennar regulators and has therefore been adopted for designing the proposed new work.

Regulators above Main Canal— G. 45 *and* 49.—Cut waters should be added at the downstream, ends of the piers in them and all similar works.

G. 48, *Regulator at* 33/6,600.—The bed width of canal may be gradually reduced from 78 feet just below the off-take channel to 52 feet at the regulator.

G. 50, *Syphon culvert.*—The thickness of arch is insufficient and must be increased to be safe against blowing up.

G. 56 *and* 77.—The piers appear to be rather thin and although they are theoretically thick enough might, I think, be slightly increased with advantage.

G. 59.—The velocity down the slope on upstream side is likely to be excessive and a drop wall would be preferable.

G. 73.—The thickness of abutments for the arches carrying canal trough and roadway on right side are unnecessarily thick and the latter applies to G. 79 also.

Paragraph 148 of the Superintending Engineer's report shows how the discharge of the Agniar has been distributed between the cross drainage works at 30/2,685 (Narayar) and 30/7,835 (Agniar) but omits to note that in order to counteract the possible miscalculations of the distribution between the two works, they are proposed to be connected by a channel as shown in the longitudinal section.

G. 62, *Surplus sluice.*—Vallam sandstone will not stand the scour and a floor to the vent is necessary.

G. 92.—For the same reason the depth of foundation of piers should be increased to at least 3 feet as although the velocity is not excessive here, the margin is hardly sufficient for a bridge.

Plan No. G 97, *Surplus sluice at* 26/74·28.—The report states that the surplus sluice is to discharge into the Pamukondamsuthi tank but it has been since found that the tank surplus weir cannot pass the discharge. It will probably be convenient to combine the surplus sluice with the proposed syphon under tunnel at 26/84·28 and provide a supply sluice for the tank at 26/74·28.

G. 102.—The thickness of the arch of the extension is less than that of the existing work and should be made the same.

25. *Grand Anicut System—Branch Canals.*—The proposals are considered generally suitable and may be accepted. It is, however, pointed out that it is desirable to avoid as far as possible the use of several different batters as seen in Plan No. G. 402 as such a course is likely to lead to mistakes during construction.

Attention is invited to the type plans for syphon well drops, which type is a new one, at any rate so far as Madras is concerned. A sample drop of this type carrying 5 cusecs was constructed last year at Red Hills tank and has worked satisfactorily. It is believed that this type will be found to be satisfactory and economical.

26. *Vadavar system.*—Superintending Engineer's paragraphs 201 *et seq.* The proposals have been described in full detail and may, it is considered, be accepted.

The Vadavar main channel has to fulfil two functions—

(*a*) as a drainage channel;
(*b*) as an irrigation channel.

As regards (*a*) there is good deal of cross drainage to be dealt with, the arrangements for the disposal of which appear to be generally adequate unless a very high flood in the Cauvery should happen to coincide with heavy local rainfall.

Such a combination has very rarely been known to occur and it is considered quite unnecessary to provide for it in designing the works.

The Superintending Engineer has accordingly remodelled the Vadavar so as to be capable of dealing with the drainage due to heavy local rainfall, while at times of high river floods it will be capable of relieving the Vennar to a maximum extent of 2,000 cusecs. The proposals will result in a great improvement in the present conditions of the Vadavar as regards cross drainage.

As regards (*b*), the Vadavar has been designed to irrigate a total area of 57,950 acres of which 14,859 acres are irrigated by it at present and 43,091 acres are to be now irrigated.

The general principles followed are considered to be suitable and may be accepted.

The following points may be specifically noticed :—

New head sluice, Plan No. V. 21.—It will be desirable to fix double shutters to the head sluice so as to lessen the quantity of sand drawn into the Vadavar during floods.

Puliampallem surplus sluice, Plan No. V. 36.—Instead of raising the body walls of the old escape weirs as proposed it is considered that automatic falling shutters might with advantage be fitted for one or both, which arrangement would enable abnormal local floods to be more rapidly run off in case of necessity.

The falling shutters should be designed to fall only when the water is, say, 6 inches above the level due to a discharge of the 2,000 cusecs which may have to be passed down to relieve the Vennar.

It is questionable if it be desirable to raise the sill of the existing vents.

Plan No. V. 30—*Muthulaimuthuvari super-passage.*—The wall between the notches should not be built above F.S.L. so as to allow the flood discharge of 2,000 cusecs to pass without being headed up.

It may be noted here that the Vennar below the proposed infall of the Muthulaimuthuvari is capable of passing the calculated maximum discharge of the Vari, as it actually passed 12,000 cusecs in the flood of 1893.

Plan Nos. 24, 25 *and* 27.—It is not anticipated that there will be any great velocity past the revetted spurs, but it may be advisable to protect the toes of the revetments with aprons.

Plan No. V. 40.—The arch is too thin and the thickness will require to be increased to guard against blowing up.

It is thought that the design of the masonry works for the distributaries are in some respects capable of improvement, but it is considered that they may be accepted for the purposes of the estimate.

For instance in some of the plans the thickness of the surcharged return walls are insufficient and in a few cases the wings are somewhat light in section, but it has not been considered necessary to alter the plans on this account as, on the whole, the estimates are adequate.

Method of estimating cost of distributaries.—The Vadavar section of the project has been worked out in complete detail and from the estimated cost of its distributaries a rate has been struck which has been applied to the distributaries under the Grand Anicut canal system to obtain their cost. The Superintending Engineer has described in full detail in sections VIII and IX of his report the principles followed by him in designing and estimating for the Vadavar distributaries and also in striking the rate to be applied to obtain the cost of those of the Grand Anicut canal.

It is therefore only necessary for me to state that I consider the principles to be correct and that the result as regards the estimated cost may be safely accepted.

I should like however to state here that it is fully recognized by the Madras Public Works Department officers that it is very necessary with new projects and especially storage projects like that now under consideration to exercise more control over the alignment and grading of the "water-courses" than has been the case hitherto. For various reasons very little control has hitherto been exercised in this direction, the chief reason being want of power to exercise any real control. The necessary power is, however, proposed to be taken in the draft Irrigation Bill now under consideration.

It may also be explained that it is not proposed to assume control over the distribution of the water in the village water-courses, but only to take steps to ensure their being laid out properly and thus automatically reduce the waste of water which occurs in the water-courses owing to their bad alignments.

C. A. Smith,
Chief Engineer for Irrigation.

31*st October* 1910.

Cauvery Reservoir Project.

General Abstract.

—	Head works.	Canal system.	—
Direct charges.	RS.	RS.	RS.
1. Works	1,71,24,000	1,13,95,972	..
2. Establishment—			
Public Works Department	36,56,678	20,70,005	Establishment.
Other departments	3,48,000	1,47,600	
3. Tools and plant—			
Ordinary	2,45,535	1,35,000	Tools and plant.
Special	20,60,000	1,00,000	
4. Suspense	50,000	30,000	.
5. Receipts on Capital account	— 3,52,368	— 49,692	..
Total, Direct charges ..	2,31,31,845	1,38,28,885	3,69,60,730
Indirect charges.			
Abatement of Land Revenue	2,22,500	4,45,650	..
Leave and Pension allowances at 14 per cent on Establishment ..	5,60,655	3,10,465	..
Total, Indirect charges ..	7,83,155	7,56,115	15,39,270
Grand total ..	2,39,15,000	1,45,85,000	3,85,00,000

For purposes of calculating Public Works Department Establishment charges and "Ordinary" Tools and Plant from the total cost of works, the cost of A. Preliminary Expenses and B. Land should be deducted.

For the Head Works the cost of Establishment, Public Works Department, on the sluice shutters and steel work Rs. 8,32,250 is only computed at 10 per cent instead of 23 per cent.

Cauvery Reservoir Project.

General abstract by heads of classification of (1) *Works.*

—	Head works.	Main canals and branches.	Distributaries.	Total.
(1) *Head works.*	RS.	RS.	RS.	RS.
A. Preliminary expenses	1,50,000	..	..	..
B. Land	6,05,000	..	..	..
C. Works	1,50,05,700	..	..	..
K. Buildings	6,31,800	..	..	..
O. Miscellaneous	5,66,500	..	..	..
P. Maintenance	1,65,000	..	..	..
Total ..	1,71,24,000	..	..	1,71,24,000
(2) *Main Canals and Branches.*				
A. Preliminary expenses	..	1,18,300	..	..
B. Land	..	6,28,000	..	..
D. Regulators	..	3,38,800	..	..
E. Falls and weirs	..	1,35,000	..	..
F. Cross drainage works	..	22,27,700	..	..
G. Bridges	..	8,86,600	..	..
H. Escapes	..	55,800	..	..
K. Buildings	..	2,33,100	..	..
L. Earthwork	..	22,62,000	..	..
M. Plantations	..	54,900	..	..
O. Miscellaneous	..	1,22,200	..	..
P. Maintenance	..	69,600	..	..
Total ..	..	71,32,000	..	71,32,000
(3) *Distributaries.*				
A. Preliminary expenses	..	..	1,36,672	..
B. Land	..	..	15,12,980	..
C. Works	..	..	13,81,040	..
L. Earthwork	..	..	11,58,760	..
O. Miscellaneous	..	..	25,350	..
P. Maintenance	..	..	49,170	..
Total ..	..	..	42,63,972	42,63,972
Grand Total (1) Works ..	..	..	..	2,85,19,972

Forecast of Financial Prospects.

PART I.—Summary of the estimated Direct Charges to Capital Account.

Year.	Works.			Establishment.	Tools and Plant.	Suspense.	Less receipts on Capital Account.	Net Total.
	Land.	Other works.	Total.					
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.
First year ..	2,10,000	12,79,000	14,89,000	2,80,200	2,75,000	70,000	1,000	21,13,200
Second ,, ..	8,06,392	17,58,000	25,64,392	4,58,400	4,89,000	1,70,000	7,000	36,74,792
Third ,, ..	8,06,392	31,13,000	39,19,392	7,76,400	5,19,000	1,40,000	9,000	53,45,792
Fourth ,, ..	71,366	30,58,000	31,29,366	7,43,600	4,65,000	— 20,000	8,000	43,09,966
Fifth ,, ..	1,26,366	35,83,000	37,09,366	8,50,600	3,32,000	— 50,000	7,000	48,34,966
Sixth ,, ..	2,36,366	31,35,000	33,71,366	7,67,600	1,76,000	— 50,000	7,000	42,57,966
Seventh ,, ..	3,46,366	32,22,000	35,68,366	7,44,600	1,14,000	— 50,000	7,000	43,69,966
Eighth ,, ..	71,366	26,39,000	27,10,366	5,94,600	71,000	— 26,000	8,000	33,41,966
Ninth ,, ..	71,366	17,35,000	18,06,366	4,39,600	49,000	— 24,000	15,000	22,55,966
Tenth ,, ..	..	12,65,000	12,65,000	3,24,800	35,000	— 30,000	59,000	15,35,800
Eleventh ,, ..	..	7,86,992	7,86,992	1,90,005	12,000	— 30,000	1,17,692	8,41,305
Twelfth ,, ..	..	2,00,000	2,00,000	51,878	3,535	— 20,000	1,56,368	79,045
Total ..	27,45,980	2,57,73,992	2,85,19,972	62,22,283	25,40,535	80,000	4,02,060	3,69,60,730

PART II.—Summary of the estimated Indirect Charges to Capital.

Year.	Capitalization of Land Revenue abated.	Charges for Leave and Pension Allowances.	Total.
(1)	(2)	(3)	(4)
	RS.	RS.	RS.
First year	61,000	39,228	1,00,228
Second ,, ...	1,67,325	64,176	2,31,501
Third ,, ...	1,67,325	1,08,696	2,76,021
Fourth ,, ...	15,000	1,04,104	1,19,104
Fifth ,, ...	35,000	1,19,084	1,54,084
Sixth ,, ...	75,000	1,07,464	1,82,464
Seventh ,, ...	1,17,500	1,04,244	2,21,744
Eighth ,, ...	15,000	83,244	98,244
Ninth ,, ...	15,000	61,544	76,544
Tenth ,, ...	..	45,472	45,472
Eleventh ,, ...	..	26,601	26,601
Twelfth ,, ...	..	7,263	7,263
Total ..	6,68,150	8,71,120	15,39,270

PART III.—Estimate of growth of Irrigation and Revenue Receipts and Charges.

Year.	Irrigated area at end of year.	Revenue receipts and charges.					
		Gross Revenue due to works.			Charges both direct and indirect against Revenue Account.	Net Revenue due to works.	
		Direct receipts.	Enhanced Land Revenue or Indirect Revenue.	Total.		Including enhanced Land Revenue.	Excluding enhanced Land Revenue.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ACS.	RS.	RS.	RS.	RS.	RS.	RS.
Sixth year ..	15,000 N_1	90,000	..	90,000	22,556	67,444	67,444
Seventh " ..	30,000 N_1	1,80,000	..	1,80,000	45,112	1,34,888	1,34,888
Eighth "	80,000 N_1 15,000 D_2	5,35,700	10,000	5,45,700	1,26,647	4,19,053	4,09,053
Ninth "	130,000 N_1 15,000 N_2 30,000 D_2	9,51,400	30,000	9,81,400	2,15,002	7,66,398	7,36,398
Tenth "	180,000 N_1 30,000 N_2 45,000 D_2	13,67,100	50,000	14,17,100	3,03,356	11,13,744	10,63,744
Eleventh "	230,000 N_1 45,000 N_2 60,000 D_2	24,28,894	72,157	25,01,051	4,25,285	20,75,766	20,03,609
Twelfth "	280,000 N_1 60,000 N_2 70,000 D_2	28,28,894	94,196	29,23,090	5,12,015	24,11,075	23,16,879
Thirteenth "	328,395 N_1 75,000 N_2 70,000 D_2	31,62,460	94,196	32,56,656	5,89,540	26,67,116	25,72,920
Fourteenth "	328,395 N_1 75,000 N_2 70,000 D_2	31,62,460	94,196	32,56,656	5,89,540	26,67,116	25,72,920

N_1 denotes newly irrigated area, single or first crop.
N_2 denotes newly irrigated area, second crop.
D_2 denotes existing delta wet second crop.

PART IV.—Estimate of net financial results of ten years after the probable date of completion of the work.

Year.	Direct capital outlay during the year.	Direct or capital outlay to end of year.	Simple interest at 4 per cent on capital outlay to end of previous year *plus* half outlay during year.	Net revenue including enhanced land revenue, columns (7) of Part III.	Simple interest *less* net revenue.	Net revenue *less* simple interest.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	RS.	RS.	RS.	RS.	RS.	RS.
First year ..	21,13,200	21,13,200	42,264	..	42,264	..
Second " ..	36,74,792	57,87,992	1,58,024	..	1,58,024	..
Third " ..	53,45,792	1,11,33,784	3,38,436	..	3,38,436	..
Fourth " ..	43,09,966	1,54,43,750	5.31,551	..	5,31,551	..
Fifth " ..	48,34,966	2,02,78,716	7,14,449	..	7,14,449	..
Sixth " ..	42,57,966	2,45,36,682	8,96,307	67,444	8,28,863	..
Seventh " ..	43,69,966	2,89,06,648	10,68,865	1,34,888	9,33,977	..
Eighth " ..	33,41,966	3,22,48,614	12,23,103	4,19,053	8,04,050	..
Ninth " ..	22,55,966	3,45,04,580	13,35,061	7,66,398	5,68,663	..
Tenth " ..	15,35,800	3,60,40,380	14,10,896	11 13,744	2,97,152	..
Eleventh " ..	8,41,305	3,68,81,685	14,58,438	20,75,766	..	6,17,328
Twelfth " ..	79,045	3,69,60,730	14,76,845	24,11,075	..	9,34,230
Thirteenth " ..	..	3,69,60,730	14,78,426	26,67 116	..	11,88,690
Fourteenth " ..	..	3,69,60,730	14,78,426	26,67,116	..	11,88,690
Fifteenth " ..	..	3,69,60,730	14,78,426	26,67,116	..	11,88,690
Sixteenth " ..	..	3,69,60,730	14,78,426	26,67,116	..	11,88,690
Seventeenth " ..	..	3,69,60,730	14,78,426	26,67,116	..	11,88,690
Eighteenth " ..	..	3,69,60,730	14,78,426	26,67,116	..	11,88,690
Nineteenth " ..	..	3,69,60,730	14,78,426	26,67,116	..	11,88,690
Twentieth " ..	..	3,69,60,730	14,78,426	26,67,116	..	11,88,690
Twenty-first " ..	..	3,69,60,730	14,78,426	26,67,116	..	11,88,690
Twenty-second " ..	..	3,69,60,730	14,78,426	26,67,116	..	11,88,690
Total ..	..	..	2,54,38,499	3,36,59,528	52,17,429	1,34,38,458
			82,21,029			82,21,029
					Deduct indirect charges ..	15,39,270

Net revenue to the credit of the project at the end of ten years after completion of project 66,81,759

Table A.

CAUVERY RESERVOIR PROJECT—STATEMENT showing expenditure to conform to programme of works.

Main heads.	Years of construction and expenditure each year in rupees.												Total rupees.
	I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	
Works.													
Head works	8,79,000	9,58,000	18,13,000	16,36,000	21,33,000	20,35,000	23,22,000	19,39,000	11,35,000	9,35,000	5,34,000	2,00,000	1,65,19,000
Distribution system	4,00,000	8,00,000	13,00,000	14,22,000	14,50,000	11,00,000	9,00,000	7,00,000	6,00,000	3,30,000	2,52,992	.	92,54,992
Land.													
Head works	1,10,000	..	..	..	55,000	1,65,000	2,75,000	..	..	..	..	..	6,[illegible]5,000
Distribution system	1,00,000	8,06,392	8,06,392	71,366	71,366	71,366	71,366	71,366	71,366	..	..	..	21,40,980
1. Total Works	14,89,000	25,64,392	39,19,392	31,29,366	37,09,366	33,71,366	35,68,366	27,10,366	18,06,366	12,65,000	7,86,992	2,00,000	2,[illegible]5,19,972
Establishment—													
Public Works establishment	2,26,000	3,90,000	7,08,000	7,01,000	8,08,000	7,25,000	7,02,000	5,52,000	3,97,000	2,90,000	1,82,005	45,678	57,26,683
Special establishment	54,200	68,400	68,400	42,600	42,600	42,600	42,600	42,600	42,600	34,800	8,000	6,200	4,95,600
2. Total Establishment ..	2,80,200	4,58,400	7,76,400	7,43,600	8,50,600	7,67,600	7,44,600	5,94,600	4,39,600	3,24,800	1,90,005	51,878	62,22,283
Tools and plant—													
Ordinary	11,000	21,000	46,000	45,000	55,000	49,000	53,000	41,000	25,000	19,000	12,000	3,535	3,80,535
Special	2,64,000	4,68,000	4,73,000	4,20,000	2,77,000	1,27,000	61,000	30,000	24,000	16,000	..	..	21,60,000
3. Tools and Plant, Total ..	2,75,000	4,89,000	5,19,000	4,65,000	3,32,000	1,76,000	1,14,000	71,000	49,000	35,000	12,000	3,535	25,40,535
4. Suspense	70,000	1,70,000	1,40,000	— 20,000	— 50,000	— 50,000	— 50,000	— 26,000	— 24,000	— 30,000	— 30,000	— 20,000	80,000
5. Receipts on Capital account	— 1,000	— 7,000	— 9,000	— 8,000	— 7,000	— 7,000	— 7,000	— 8,000	— 15,000	— 59,000	— 1,17,692	— 1,56,368	— 4,02,060
A. Total Direct charges	21,13,200	36,74,792	53,45,799	43,09,966	48,34,966	42,57,966	43,69,966	33,41,966	22,55,966	15,35,800	8,41,305	79,045	3,69,60,730
Capitalized abatement of land revenue ..	61,000	1,67,325	1,67,325	15,000	35,000	75,000	1,17,500	15,000	15,000	..	.	..	6,68,150
Leave and pension allowances	39,228	64,176	1,08,696	1,04,104	1,19,084	1,07,464	1,04,244	83,244	61,544	45,472	26,601	7,263	8,71,120
B. Total Indirect charges	1,00,228	2,31,501	2,76,021	1,19,104	1,54,084	1,82,464	2,21,744	98,244	76,544	45,472	26,601	7,263	15,39,270
Grand Total ..	22,13,428	39,06,293	56,21,818	44,29,070	49,89,050	44,40,430	45,91,710	34,40,210	23,32,510	15,81,272	8,67,906	86,308	3,85,00,000

Table B.

STATEMENT showing the simple interest on capital outlay at 4 per cent as per Table A year by year up to date of completion of works.

Years.	Outlay.	Interest.												
		First year.	Second year.	Third year.	Fourth year.	Fifth year.	Sixth year.	Seventh year.	Eighth year.	Ninth year.	Tenth year.	Eleventh year.	Twelfth year.	Thirteenth year.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.
First year	21,13,200	42,264	84,528	84,528	84,528	84,528	84,528	84,528	84,528	84,528	84,528	84,528	84,528	84,528
Second "	35,74,792	..	73,496	1,46,992	1,46,992	1,46,992	1,46,992	1,46,992	1,46,992	1,46,992	1,46,992	1,46,992	1,46,992	1,46,992
Third "	53,45,792	..	..	1,06,916	2,13,832	2,13,832	2,13,832	2,13,832	2,13,832	2,13,832	2,13,832	2,13,832	2,13,832	2,13,832
Fourth "	43,09,966	..	..	..	86,199	1,72,398	1,72,398	1,72,398	1,72,398	1,72,398	1,72,398	1,72,398	1,72,398	1,72,398
Fifth "	48,34,966	..	..	..	..	96,699	1,93,398	1,93,398	1,93,398	1,93,398	1,93,398	1,93,398	1,93,398	1,93,398
Sixth "	42,57,966	..	..	..	..	..	85,159	1,70,318	1,70,318	1,70,318	1,70,318	1,70,318	1,70,318	1,70,318
Seventh "	43,69,966	..	..	..	..	..	..	87,399	1,74,798	1,74,798	1,74,798	1,74,798	1,74,798	1,74,798
Eighth "	33,41,966	..	..	..	..	..	..	..	66,839	1,33,678	1,33,678	1,33,678	1,33,678	1,33,678
Ninth "	22,55,966	..	..	..	..	..	..	..	..	45,119	90,238	90,238	90,238	90,238
Tenth "	15,35,800	..	..	..	..	..	..	..	..	..	30,716	61,432	61,432	61,432
Eleventh year	8,41,305	..	..	..	..	..	..	..	..	..	..	16,826	33,652	33,652
Twelfth "	79,045	..	..	..	..	..	..	..	..	..	..	..	1,581	3,162
Total ..	3,69,60,730	42,264	1,58,024	3,38,436	5,31,551	7,14,449	8,96,307	10,68,865	12,23,103	13,35,061	14,10,896	14,58,438	14,76,845	14,78,426
Accumulated Total ..	..	..	2,00,288	5,38,724	10,70,275	17,84,724	26,81,031	37,49,896	49,72,999	63,08,060	77,18,956	91,77,394	1,06,54,239	1,21,32,665

CAUVERY RESERVOIR PROJECT.

Condensed Abstract of Cost.

Departmental head.	Head works.	Canal system.	Total.
A. Direct Charges.	RS.	RS.	RS.
1. Works	1,71,24,000	1,13,95,972	2,85,19,972
2. Establishment, Public Works Department	36,56,678	20,70,005	62,22,283
Establishment, other departments ..	3,48,000	1,47,600	
3. Tools and plant, ordinary	2,45,535	1,35,000	25,40,535
Do. special	20,60,000	1,00,000	
4. Suspense	50,000	30,000	80,000
5. Receipts on Capital account	— 3,52,368	— 49,692	— 4,02,060
Total, A. Direct Charges ..	2,31,31,845	1,38,28,885	3,69,60,730
B. Indirect Charges.			
Abatement of land revenue	2,22,500	4,45,650	6,68,150
Leave and pension allowances	5,60,655	3,10,465	8,71,120
Total, B. Indirect Charges ..	7,83,155	7,56,115	15,39,270
Grand Total ..	2,39,15,000	1,45,85,000	3,85,00,000

APPENDICES.

APPENDIX I.

I

Note on the Cauvery Reservoir Project, Madras Presidency, by Mr. J. Benton, C.I.E., Inspector-General of Irrigation, dated 17*th September* 1906.

I.—ADMINISTRATIVE.

Location and general description of works.—Referring to the blue printed map in the pocket of the estimate received with the Madras Government letter No. 597 I, dated 1st June 1906, the Cauvery reservoir project consists chiefly of the following :—

(i) Construction of a high masonry dam on the Cauvery river, five miles north of Neringipet.

(ii) Construction of east and west side channels taking out above this dam for the irrigation of the narrow belts indicated on the map.

(iii) Construction of works for irrigation of the small Perambur block.

(iv) Construction of works to admit of the irrigation of the Tirutturaippundi block.

(v) Execution of the Vadavar-Pattukkottai project comprising the following works :—

(*a*) Widening the existing natural channel of the Vadavar river for 16¼ miles.

(*b*) Construction of the new canal, 14 miles in length, to the proposed Katt a reservoir.

(*c*) Construction of Kattar reservoir.

(*d*) Construction of a system of distributaries from the works (*a*), (*b*) and (*c*).

I will now state some leading particulars of these proposed works.

2. *Dam on the Cauvery.*—This great storage reservoir is said to be chiefly required—for rendering the supply of water more assured to existing irrigation of about 980,000 acres in the Cauvery delta, for extending second-crop irrigation in the delta, and also for admitting of irrigation of the certain additional tracts. A further but subsidiary object is the irrigation of the tracts commanded by the east and west side channels. The following are some of the leading particulars of the masonry dam :—

(i) Site one with steep sides and bed all in rock.

(ii) Full supply level 129 feet above lowest part of river-bed, top of dam 7 feet and top of parapet 10 feet over full supply level.

(iii) Lake formed by dam will extend about 34 miles up the river, and will have a width varying from 1 to 3 miles. Capacity 40,000 millions cubic feet.

(iv) Length of dam 4,900 feet.

(v) Maximum floods estimated at 250,000 cusecs are proposed to be passed through 70 sluices in the body of the dam with a maximum velocity of 30 feet per second.

(vi) Sluices to be provided at the ends for passing water into the east and west side channels.

(vii) The body of the dam is to be of rubble masonry with superior classes of masonry near the vents.

3. *Leading particulars of the various tracts.*—The following table shows particulars of the various tracts and their relative importance :—

Part of system.	Annual irrigation.		Receipts.		
	First crop.	Second crop.	Direct.	Indirect.	Total.
	ACS.	ACS.	RS.	RS.	RS.
East side channel	27,000	21,600	2,14,950	..	2,14,950
West side channel	18,864	17,284	1,62,738	171	1,62,909
Perambur block	5,091	4,091	39,120	4,351	43,471
Tirutturaippundi block	18,715	..	74,894	2,664	77,558
Vadavar-Pattukkottai	157,992	34,230	7,43,650	45,509	7,89,159
Extension second crop in delta	..	70,000	2,60,000	..	2,60,000
Total ..	227,662	147,205	14,95,352	52,695	15,48,047

4. A Special Revenue officer was appointed to examine the revenue prospects of the various works, and on the Revenue Board examining and amending his results, the Local Government accepted the figures given in the above table as quite safe estimates of what is likely to be attained. With regard to the various tracts they may be subdivided as follows :—

(i) The inland high level tracts comprising those under the east and west side channels proposed to be constructed in exceedingly difficult shelving ground requiring terracing to a large extent. The soil is very poor, maintenance will be costly, and returns very uncertain. I will discuss these tracts in greater detail after I have shown what the incidence of cost on each part of the project is.

(ii) The deltaic tracts comprising all the other areas proposed to be irrigated. There are no difficulties in construction of the works for these areas; the soil is of excellent quality, and the returns are assured.

An attempt is here being made to combine the two schemes, (i) *supra*, which are really protective irrigation works never likely to pay their way with the group of works, (ii) *supra*, which can be made productive. As will be shown below, this combination affords financial results which do not appear to admit of the project being sanctioned under existing rules.

5. *Comparison of first and second estimates.*—The first estimate was received with the Local Government's letter No. 972, dated 2nd September 1904, and was returned with Government of India letter No. 83 C.W.—I., dated 10th January 1905, for reconsideration of certain revenue and constructional features in the project, and for some omissions to be made good. The following table affords a comparison of the first and second estimates :—

Particulars.		First estimate.	Second estimate.
Amount of estimate for direct and indirect charges	Rs.	2,77,78,000	2,92,39,000
Annual irrigation for first and second crops	Acres	372,330	374,867
Gross revenue	Rs.	19,18,581	15,48,047
Net "	"	16,89,680	13,01,540
Return on capital expenditure	Per cent	6·1	4·45

I have shown as the amount of the second estimate in the above table that given by the Local Government, but, as will be shown below, there are reasons for increasing the Rs. 2,92,39,000 to Rs. 2,94,57,691. The second estimate, that now under consideration, submitted with the Local Government's letter No. 597 I., dated 1st June 1906, shows that the estimated cost has been considerably increased, the annual irrigation slightly so, while the revenue has been so greaty reduced that, instead of promising to yield a return of 6·1 per cent on the capital expenditure, the return now arrived at is only 4·45 per cent. The revenue prospects of the project have been thoroughly investigated as far as I can see; with regard to amendments of the estimate suggested in the note of the late Inspector-General of Irrigation, dated 22nd April 1905, I regret to state that these have not in my opinion been carried out so as to show with requisite accuracy what the project will really cost; the alterations referred to in the note of the Chief Engineer for Irrigation, dated 9th April 1906, paragraphs 9, 10, 11, 15, 18, 19, 20 and 21 are cases in point. In the technical note given below I will reply to the reasons given by the Chief Engineer for not carrying out the alterations suggested. Meanwhile I would suggest that labour should not be spared now in framing reliable estimates, since failure to do so is certain to result in disappointments hereafter.

6. The work is estimated to occupy seven years in construction. The criterion of a work being productive is that ten years after completion it will repay the interest on capital invested with all arrears of simple interest up to that date, and also the indirect charges of capitalized abatement of land revenue, and leave allowances and pensions. The two estimates under consideration give as follows :—

Particulars.	First estimate.	Second estimate.
	RS.	RS.
Net revenue less simple interest at end of 17th year	+ 46,75,823	— 11,42,401
Indirect charges	— 23,88,000	— 10,78,800
Total ...	+ 22,87,823	— 22,21,201

The first estimate showed the work to be productive, but the second one now under consideration does not do so, since it only shows a return of 4·45 per cent on the capital expenditure and is Rs. 22,21,201 short of the requisite receipts ten years after completion.

7. *Sanction of work.*—Irrigation projects have to be classed under one of the following Account heads :—

	PARAS
(i) Productive Works, Public Works Department Code, Volume II.	2123
(ii) Protective Works ,, ,,	2199
(iii) Minor Works and Navigation, Public Works Department Code, Volume II	2303

The project does not fulfil the conditions of (i) *supra*, while it is only protective so far as the east and west side channel tracts are concerned ; it cannot be classed under (iii) *supra* ; under these circumstances the Local Government trusts that the Government of India will be pleased to move the Secretary of State to sanction the project under Productive Works as a special case. I am afraid there may be grave financial objections for an entirely new departure of this kind. I will propose an alternative below, which will, I trust, obviate the need for asking the Secretary of State to have a non-productive work classed as a productive one.

8. *Corrections in estimate.*—The second estimate contains what appear to me to be some clerical errors as explained below :—

(i) The Special Revenue officer estimated the cost of land compensation at Rs. 13,30,000 ; of this amount Rs. 5,50,000 is for the head reservoir and Rs. 4,50,000 for the Kattar tank. The detailed estimates received show that the cost of land has been estimated at Rs. 14,20,884. Although the amount Rs. 13,30,000 is shown for land in the abstract given at page 15 of the estimate, the amount included in Rs. 2,27,18,012 is Rs. 14,20,884 ; hence the figure for works Rs. 2,13,88,012 is also apparently incorrect. The corrections which seem to be required in the various estimates are given in the annexed Appendix I, column 4.

(ii) The Public Works Department Code, Volume II, paragraph 2119 (i) and (iv), lays down that the provision for ordinary tools and plant is to be 1·5 per cent and for establishment 23 per cent on works. The provision made in the abstract of the estimate is Rs. 35,136 short for tools and plant, and Rs. 2,62,739 short for establishment. In the annexed Appendix II I have given what appears to me to be a correct abstract of the estimate, the net result being an increase of Rs. 2,18,691 on the second estimate.

9. *Cost of each part of the project.*—I have prepared Appendix III to show this, in order to be able to eliminate unprofitable works as will be seen below.

10. *Capital return from each part of the scheme.*—This is shown by the annexed Appendix IV. In preparing this appendix, I have distributed the cost of the dam over the various schemes in proportion to the gross revenue from these as shown in column 7. The figures in the last column show the inferior character of the projects for the east and west side channels, and suggest the advisability of excluding these works and of finding a market in the delta for the water-supply thus set free.

11. *Objections to including the east and west side channel tracts.*—These are as follows :—

(i) Inclusion makes the project non-productive and sanction under existing rules difficult.

(ii) The land in both tracts is stated to be poor in quality, and it is therefore likely to be suitable for double cropping with rice.

(iii) The Chief Engineer considers that terracing will be necessary, but the Special Revenue officer states this will only be needed to a limited extent ; since I find on examining all the lines of cross-section levels that the slope of the ground is on the average about 1 in 155 in the two tracts, I conclude that the Chief Engineer is right. Assuming that the cultivators would execute the work themselves by scrapers hauled by bullocks, there would be about 4,500 cubic feet of earth to move per acre in levelling and constructing banks so as to have fields about 50 feet in width measured down the slope and 200 feet in length in the other direction. The execution of so much work over nearly 46,000 acres will greatly retard development of irrigation, and, instead of the full area being irrigated six years after completion of the project, it may be found that twenty years will lapse before this is accomplished. This will affect the financial forecast seriously.

(iv) A larger area can be irrigated by sending the water-supply to the delta, and the returns will be enhanced while the expenditure will be less.

(v) The tortuous character of the alignments is quite unsuited for large canals carrying 896 and 696 cusecs as proposed for the east and west side channels. If irrigation of dry crops on only a sufficient part of the area to keep the people off relief works is aimed at, canals of one-third the capacity will answer ; these can go round sharp curves in crossing ridges and ravinus, and will be comparatively cheap works.

(vi) The amount of flood water proposed to be passed over by level-crossings will, in my opinion, result in the canals having large quantities of silt brought into them by the nullahs and in breaches of the banks being of such frequent occurrences as to make the canals unworkable. To provide proper drainage crossings would require an addition of from Rs. 6,00,000 to Rs. 7,00,000 to the project estimate.

12. *Alternative scheme.*—Under the circumstances explained above I would propose as follows :—

(i) To eliminate the east and west side channels from the project now under consideration, and to substitute in lieu thereof the Vadavar-Pattukkottai extension shown on the map given opposite page 44 of the first estimate, which it is stated will irrigate 70,000 acres of first crop.

(ii) If the east and west side channel tracts are considered worth irrigation, which I personally doubt—to contemplate irrigation of these hereafter under a separate scheme chargeable to Protective Irrigation works. The irrigation provided to be that for dry crops.

I will now examine the effect of these alterations as regards areas to be irrigated, water-supply and revenue.

13. *Areas irrigable.*—The assumptions made in the project are, that each cusec used on the east and west side channels will irrigate there 30 acres, and that half of the cusec will find its way back to the river, and at the assumed duty of 66 acres per cusec will irrigate in the delta 33 cusecs. Hence the total area irrigated per cusec used in this way will be 30 + 33 = 63 acres; if the water did not pass through the east and west side channel systems, it would, if passed directly down the river, irrigate 66 acres in the delta. Confining attention to the full supply required for first crop we have as follows according to these assumptions :—

	Area, first crop.	Supply required.
	ACS.	CUSECS.
East side channel	27,000	896
West „	18,870	629
	45,870	1,525

Of the 1,525 cusecs used as above half or 763 cusecs finds its way to the river and irrigates there 763 × 66 = 50,358 acres; hence the total area irrigated by the 1,525 cusecs will be as follows :—

	ACS.
In east and west side channels	45,870
In delta „ „	50,292
	96,162

If the same supply was sent direct to the delta, it would irrigate of first crop there—

1,525 × 66 = 100,650 acres.

Hence, if the requisite commanded area can be got in the delta a greater area by 100,650 − 96,162 = 4,488 acres can be irrigated by passing the water directly down the river.

14. *Available water-supply.*—If the change I propose is made, there will be available for extra irrigation in the delta over and above that contemplated in the project—

	CUSECS
Total as above	1,526
Deduct seepage supposed in the project so pass down from the east and west channels and already set aside for other parts of the delta ...	763
	763

15. *Additional irrigation in the delta.*—This supply will be available for extension of irrigation in the delta beyond the limits of the project and it will suffice for an area of 763 × 66 = 50,358 acres first crop. As regards the area of second crop the east and west side channels, according to paragraph 3 *supra*, are supposed to irrigate—

	ACS.
First crop	45,864
Second crop	38,884

Hence we may assume that the water-supply for the second crop will suffice for irrigation in the delta in this crop of an area of—

$$\frac{50,358}{45,864} \times 3,884 \doteq 42,000 \text{ acres nearly.}$$

This would give 50,358 acres of first crop and 42,000 acres of second crop, total extra annual irrigation in the delta 92,358 acres; however this would give an unusually large proportion of second crop and I will therefore assume that the following safer proportions may be attained :—

	ACS.	PER CENT.
First crop	70,000	82
Second crop	15,000	18
Total ...	85,000	100

The following is the irrigation on the Vadavar-Pattukkottai scheme as accepted by the Local Government—*vide* paragraph 3 *supra* :—

	ACS.	PER CENT.
First crop	157,992	82
Second crop	34,230	18
Total ...	192,222	100

It will be seen that the former set of figures are respectively about 44 per cent of the latter; on this basis the net revenue from the extension—*vide* Appendix IV, work No. 6, column 11—would be—

$$\frac{44}{100} \times \text{Rs. } 6{,}32{,}487 = \text{Rs. } 2{,}78{,}294.$$

16. *Cost of extension.*—The available data do not suffer for the accurate calculation of this, and the following is advanced as a rough approximation. Basing the cost on that of the Vadavar-Pattukkottai scheme for direct and indirect charges, the cost of the Kattar tank should be deducted from the latter.

	RS.
Vadavar-Pattukkottai scheme—*vide* Appendix IV	53,23,498
Deduct Kattar tank	15,79,877
	37,43,621

Cost of proposed extension $\frac{44}{100} \times$ Rs. 37,43,621 = 16,47,193

17. *Amount of project with alternative scheme.*—Referring to Appendix IV if the works Nos. 2 and 3 are omitted and those for the alternative now proposed added, the results are as follows :—

Scheme.	Probable cost.	Net revenue.	Return on capital cost.
	RS.	RS.	
Works Nos. 1 and 4 to 7	2,33,44,370	9,76,960	..
Proposed extension as above ..	16,47,193	2,78,294	..
Total ..	2,49,91,563	12,55,254	5·02

Provided the above rough estimate is substantially correct, and that savings and excesses on other parts of the estimate balance each other, the adoption of the alternative promises to make the scheme a productive one.

18. *Extension Tirutturaippundi Project.*—Referring to the first paragraph of the section of the first estimate bearing on this part of the scheme, the uncommanded area is 30,000 acres as shown on plate No. 26. I observe that the grading of the Mulliyar channel can be slightly raised so as to give extra command at the tail. I would recommend that command by flow of this tract may be arranged for, if feasible, at reasonable cost; the extra cost will be moderate, while the extra annual revenue will be about Rs. 70,000. This will, I believe, make the project quite safe to be a productive one even when some unavoidable extra charges are made.

19. *Comparison of project of Local Government with the alternative.*—The following table shows how the project and the alternative compare when taking no credit for the suggested addition, paragraph 18 *supra* :—

Particulars.	Corrected project.	Alternative.
Cost, direct and indirect	Rs. 2,94,57,691	Rs. 2,49,91,563
Annual irrigation, first crop	Acres 227,662	Acres 251,798
" " second crop ...	" 147,205	" 123,321
Total area ...	Acres 374,867	Acres 375,119
Net revenue	Rs. 13,01,537	Rs. 12,55,254
Return on capital expenditure ...	4·4 per cent.	5·0 per cent.

Having no particulars as to Indirect returns on the extension, I have not shown any credit on this account; in the case of the Vadavar-Pattukkottai scheme the credit is Rs. 45,509 —*vide* Appendix IV—and if there is to be corresponding credit of 44 per cent of this amount on the extension, the return on the Capital expenditure would become 5·1 per cent.

20. *Conclusion.*—In concluding this part of my note I would recommend as follows:—

(i) Substitution of the proposed Vadavar-Pattukkottai extension south of Kattar reservoir for the east and west side channel tracts; the latter can be dealt with hereafter if there is water to spare to an extent sufficient for the irrigation of dry crops.

(ii) Regrading at a higher level of the Mulliyar river bed and irrigation of the tract of 30,000 acres at the tail which is uncommanded by the present project.

(iii) Submission with the third estimate of a proper index map in colours of the whole of the Cauvery valley in the Madras Presidency, showing tanks, rivers, existing canals and the sea in blue, existing irrigation from canals, and tanks in green to the extent of the commanded areas, proposed canal and distributary alignments in red, commanded areas of proposed canals in pink, the sites of important works at canal heads, hills in Indian ink shading, district and tahsil boundaries by distinctive lines, the names of all places mentioned in the report, and other places of importance, railways and topographical features required to make a complete map. The scale should not be less than 1 inch to 8 miles, and 1 inch to 4 miles would be preferable.

(iv) That the report should give a brief general account of existing irrigation, of irrigation possibilities, and it should show that the project fits in with the probable ultimate arrangements for turning all available water supplies in the Cauvery valley to the best advantage.

II

Note on the Cauvery Reservoir Project, Madras Presidency, by Mr. J. Benton, C.I.E., Inspector-General of Irrigation, dated 27th March 1908.

Site of masonry dam.—I inspected the site of this work with Mr. H. E. Clerk, Chief Engineer, and I consider it generally suitable. The rock is of good quality. The wide high cultivated berms on each side lying between the deep channel and the river are shown as only having good rock at about the same level as in the river bed, and the trial pits dug on the centre line admit of no doubt on this subject, as far as this particular line and others near it which were examined are concerned; however outcrops of apparently durable rock occur on ground surface not very far from the lines on which trial pits were dug, and there is nothing to show conclusively that the digging of more trial pits may not reveal the location of a higher and more suitable rock foundation. The project estimate may be accepted for the section on which it is based, but before actual execution is carried out I would recommend that the ground may be more fully examined. The rates for work may also be reconsidered.

2. No map showing sites of quarries has been included in the project, and I would suggest that the stone procurable from various sites may be carefully considered, and that the rates may be based on the cost of getting, that of carriage to site, and on the cost of labour.

3. The construction of the dam will close the existing road, and provision for a substitute should be made in the estimate; it remains to be decided whether the road should skirt the water, or be on the south side of the range of hills. No provision has been made for this road in the estimate.

4. *Previous note on this work.*—In my note, dated 17th September 1906, paragraph 7, it was pointed out that the project, as submitted with the Madras Government letter No. 597 I., dated 1st June 1906, could not be sanctioned under existing rules as it did not fulfil the conditions of either a Productive, Protective or Minor Work. It was shown that the project in its productive aspect was prejudiced by including the east and west side channels where a protective work is required, and might be justifiable, and that protective works were not required elsewhere in the scheme. The following proposals were, therefore, made in paragraph 20 of the note above quoted:—

(i) That the Vadavar-Pattukkottai canal extension south of Kattar reservoir might be substituted for the east and west side channels, since this would improve the financial aspect of the project.

(ii) That regrading of the Mulliyar river should be undertaken so as to increase the tail irrigation by 30,000 acres.

(iii) That the index map should comprise the whole of the Cauvery valley, and should show all existing and proposed works, and the chief topographical features.

(iv) That the report on the amended estimate should contain a brief account of existing irrigation, and of irrigation possibilities in the Cauvery valley.

The object of the proposals (i) and (ii) *supra* was to make the project more productive; while the object of the proposals (iii) and (iv) *supra* was to have assurances "that the project fits in with probable ultimate arrangements for turning all available water-supplies on the Cauvery valley to the best account." Neither the index map nor the report served to show the physical character, on the requirements of the great tract on the south of the Cauvery river from the confluence of the Amaravati down to the proposed Vadavar-Pattukkottai channel.

5. *Action by the Madras Government.*—The Madras Government in reconsidering the scheme have made the following important advances on the proposals paragraphs 4 (i) and (ii) *supra* :—

(i) Substitution for the proposed Vadavar-Pattukkottai channel of one on the same side of the Cauvery at a much higher level with off take at the Grand anicut.

(ii) Elimination of the proposed Kattar reservoir.

(iii) Elimination of the Tirutturaippundi extension of irrigation; and also omission of irrigation to the additional 30,000 acres mentioned in paragraph 4 (ii) *supra*.

The reasons for the proposed eliminations (ii) and (iii) *supra* were, that the land is low, that remissions from some low tracts in the Cauvery delta have now to be given on account of defective drainage, and that the whole of the available supply set free from the east and west side channels, as well as from the Tirutturaippundi extension could, it is considered, be utilized on the one high level canal referred to in paragraph 5 (i) *supra*. These reasons of the Local Government for investigating a different scheme to that suggested by Government of India have much to commend them, and but for the lack of the further information indicated in paragraph 4 (iii) and (iv) *supra* procedure in the same direction would probably have been suggested by Government of India. I wish to here explain that the greatest difficulty to be overcome in this scheme is to make it productive; very few storage schemes are productive.

6. *Alignment of high level canal.*—I have had the advantage of inspecting with the Chief Engineer, Mr. H. E. Clerk, the most important portions of the alignment of this canal as detailed below:—

(i) The offtake from the Cauvery up-stream of the Grand Anicut.

(ii) The proposed heavy laterite cutting of 3 miles in length at Tanjore where the maximum depth is 34 feet.

(iii) We also considered the grading which is generally as follows:—

R.D.	Depth.	Slope.
	FT.	
0 4 miles	6	0·75 foot per mile.
4 27 ,, ...	10	0·25 ,, ,,
27 30 ,, ...	10	Various steep slopes.
30 76 ,, ...	..	0·5 foot per mile in upper part. 1·0 ,, ,, lower part.

7. With regard to paragraph 6 (i) *supra* it is not clear that the requisite head can be got to force in a supply of 6 feet in depth into the canal. The works at the Grand anicut are—

(*a*) Grand Anicut surplusing sluices with cill about 3 feet above bed of the Cauvery.

(*b*) Regulators over the Cauvery and Vennar affluents, with a horizontal floor about the normal bed of the river.

All these works have sluice gates extending completely across the channels which they control, and by operating these water could be held up to 11 feet over the floor of the regulators; however the effect of holding up low depths, such as 2 or 3 feet which have frequently obtained in the monsoon in the past to 7 or 7·5 feet, to give 6 feet in the proposed new canal would in the light of experience elsewhere be to cause shoals of sand and islands in the present admirably clear channel up-stream. When the supply for the delta is augmented by the additional supply from the proposed great dam at Narinjapet, the depth in the river will exceed 2 or 3 feet; however there is nothing to show that the depth will always be such as to obviate undesirable heading up, and shoaling up-stream. It is true that the offtake table for the driest year shows no heading up would be required, but the depth in the river above the anicut half-month by half-month, or month by month requires to be worked out for the whole of the series of years for which the working of the reservoir is shown. It is not understood how the increase of supply to first crop in the Cauvery delta can be so great as to raise low depths of 2, 3 or 4 feet in the river to 6·5 to 7·5 feet required for the proposed new canal, while affording no extra area of irrigation or of revenue in the first crop on the Cauvery below the Grand Anicut. It has to be borne in mind that a silt deposit of 2 feet in the proposed new canal might require nearly 7·5 feet in the river to force down full supply. The above will serve to show that an offtake above the Grand Anicut involves serious difficulties, and subject to what investigations may show, it may be found that there are insuperable objections to this proposal.

8. With regard to paragraph 6 (ii) *supra* a 34 feet cutting in laterite will be rather costly, but still it is quite feasible, even when the length is 3 miles; however I fear that the maximum depth will be much greater as shown below. The alignment cannot be improved on to lessen this cutting.

9. With regard to paragraph 6 (iii) *supra* a slope of 0·25 foot per mile is only about one-third what is usually allowed for a canal taking off a river carrying large quantities of very coarse silt. There is nothing to show that a canal with this very flat slope will keep open. The report on the Cauvery Reservoir project shows that the river carries enormous quantities of silt at the Grand Anicut, the slope of the river being about 3 feet per mile. It would be a fatal mistake to construct a canal which cannot be kept open and it would be unwarrantable to advise Government to sanction such a work. The silt of the Cauvery is coarser than that of any of the rivers of Northern India which I am acquainted with and for canals from the latter to carry 3,300 cusecs the slope shown in the following table would be held to be the flattest allowable for the depths and widths shown :—

N = 0·020.

Discharge.	Bed width.	Depth.	Side slopes.	Bed slopes.	Mean velocity.	Critical velocity Vo.
	FT.	FT.				
3,300 Cusecs	108	8	½ to 1	1/5714	2·99	1·02 Vo.
,, ,, ...	90	9	,,	,,	3 13	1 01 Vo.
,, ,, ...	78	10	,,	,,	3·31	Vo.

If reference is made to Mr. R. G. Kennedy's Hydraulic Diagrams it will be seen that these channels would just be free of silt if the material was similar to that in the north of India; however the Cauvery sand is coarse and a rather steeper slope might be advisable.

10. I recommend the abandonment of the flat slope of 0·25 foot per mile = 1/21,120 and the adoption of one which experience has shown to be suitable under similar circumstances. The effect of this change will be to greatly increase the depth and cost of 4 miles of laterite cuttings which cannot be avoided owing to proximity to the railway, and to Tanjore town. Retaining the proposed slope of 0 75 foot per mile in the first 4 miles, and increasing the slope from R.D. 4 to 27 miles from 0·25 foot to 24 foot = (1/5714) would lower the bed at the end of the 27th mile by 16 feet, and thus give cutting of 50 instead of 34 feet. At other parts an alignment further down the slope can be chosen. Lowering the level of the canal involves a sacrifice of command; it may be thought that this is of no importance since the commanded area will still be ample; however, subject to the essential condition of evolving a productive work, it is advisable that the culturable area should be from 3 to 4 times the average annual irrigation, since it is very desirable to benefit the greatest number and not to merely enrich a small number of people. A wide market hastens development since there would be more labourers available for cultivation and for the heavy task of terracing; also it steadies and ensures the demand. It is true that due to proximity of the delta market for labour, the tract is not an accepted famine one; however, if feasible it will be advisable, to distribute the benefits of irrigation widely, to provide labour and food for as many people as possible in their own villages, and to leave it to others who cannot be provided with irrigation to supply the delta wants for labour in scarcity and famine times. This aspect of an enlarged commanded area leads to consideration of the alternative mentioned below.

11. *Alignment for Grand Anicut sites.*—This has been very well laid out for 76 miles as far as the physical features of the ground are concerned; however the assumed bed slope of 0·25 foot per mile necessitates revision while the last 20 miles lies through tank ayacuts for a considerable part of this length. It is advisable to shorten the southern prolongation.

12. *Katali offtake.*—In order to get over the difficulties in connexion with the proposed offtake at the Grand Anicut, the following alternative sites were considered in conjunction with the Chief Engineer :—

(i) Bridge over the Cauvery 3 miles up-stream of the Grand Anicut.

(ii) Utilization of the Wyakondan channel, the offtake of which is about 29 miles up-stream of the Grand Anicut.

(iii) Offtake at Katali, 44 miles up-stream of the Grand Anicut, and just below the confluence of the Cauvery and Amaravati rivers where a rock foundation is stated by Mr. J. H. Medlicott, Superintending Engineer, to be available and who accordingly suggested this site for consideration.

13. With regard to the site, paragraph 12 (i) *supra*, precisely the same difficulties present themselves here as at the Grand Anicut, as regards taking off a canal carrying a depth of 6 feet from a river liable to go down to 2 to 4 feet. The bridge has a rubble masonry floor about 30 feet in width; however to provide this with falling shutters of, say, 4 feet in height, and strengthening and lengthening the floor would cost from Rs. 75,000 to Rs. 1,00,000. This

site has the advantage over the one at the Grand Adicut of not interfering with three important existing works; also since the offtake would be 8·8 feet higher, the four miles of laterite cuttings would be reduced by this amount less the fall of 2·8 feet in three miles of extra length of canal; hence the saving in cutting would be about 6·0 feet as compared with the Grand Anicut offtake; this would reduce the depth of the cutting from 50 to 44 feet. This would give 24 square miles more of commanded area than the Grand Anicut offtake. The old Vennar channel could possibly be used for part of the three miles from the offtake to opposite the Grand Anicut; however this is doubtful, whereas it is certain that a fairly large drainage crossing would be necessary in this length.

14. With regard to the proposal, paragraph 12 (ii) *supra*, the existing channel is much silted up; it would admit of an 80 feet bed width for the first 19 miles, but some additional land would be required, while in passing through Trichinopoly it would be rather difficult to make the existing channel of about 50 feet in width carry the supply of some 4,000 cusecs without a good deal of compensation having to be paid for land and houses. From 19 miles to 29 miles opposite the Grand Anicut a new channel would have to be excavated. It would be necessary to take out sufficiently far up the river to command all the existing irrigation, and this results in the upper anicut being an unsuitable site. This proposal has the disadvantage of not having a favourable offtake, while the simplest form of dam with falling hutters would cost a considerable amount, since the river channel is about 3,000 feet in width and the sub-soil sand. A project is now under consideration for improving this channel at a cost of about Rs. 60,000. The cost of temporary bunds to force water into this small canal will be from Rs. 5,000 to Rs. 10,000 annually.

15. With regard to the proposal, paragraph 12 (iii) *supra*, particulars were not available during my tour as to the depth at which rock is met with and the probable cost of a masonry anicut to hold up the low supplies so as to serve the canal if taken off from here. Providing the cost of the anicut will not make this offtake prohibitive, the following advantages would attach to its adoption —

(*a*) The commanded area would be increased by over 50 per cent so that the culturable commanded area would be about three times the average annual irrigation.

(*b*) All deep cuttings would be avoided and the high lands round Trichinopoly could be made into gardens.

(*c*) The cold weather supply of the Wyakondan could be drawn from the high level canal which might warrant further expenditure; however, 15 miles of extra carrying capacity would probably balance this.

16. The Chief Engineer decided to send the survey party to examine and survey the proposed site paragraph 12 (iii) *supra* for the dam, particularly with regard to the level, extent and character of the rock, and the probable cost of this work; further it was decided to lay out a probable canal alignment on a falling contour. This information will serve to show how the cost of this work will compare with that of the alignment from the Grand Anicut. If the cost of the former is not in excess of that of the latter to an extent which will make the project unproductive, I would recommend that the high level canal from Katali may have the preference. In making this comparison the saving in temporary bunds for the whole of the existing small canals may be capitalized. No extra carrying capacity would probably be required for these small canals since the monsoon capacity of the canal from Katali would suffice for the cold weather supply for both, while the Wyakondan could continue to operate as at present during the monsoon.

17. *Fixing level of the proposed Katali channel.*—Inspection of the site and cross sectioning of the river for about half a mile above and half a mile below, with proding to determine rock levels, will serve to show whether the site is one where an anicut consisting of a single masonry wall can be cheaply constructed; if the reply is in the affirmative then the following may be determined from the surveys:—

(i) The general slope of the river-bed for the half mile of its course down-stream of the work.

(ii) The reduced level (R) of this average bed at the site.

(iii) The depth (*d*) of the present low cold weather supply over this average bed line at the site of the work.

For the preliminary surveys the ground level of the contour (*c*) at starting may be as follows:—

Depth of water in feet (*d*).	Reduced level of river-bed.	Level of contour (*c*).	Remarks.
2	R	R+0·5	The figures in the last column are the nearest to half feet and full feet.
3	R	R+1·0	
4	R	R+2·0	
6	R	R+3·0	

The figures in the last column of the above table are based on the following assumptions :—

(*a*) That it is undesirable to have a weir which will raise cold weather low water level by materially more than 3·5 feet.

(*b*) That it is necessary for scouring to have floor of regulator at least 1 foot and preferably 2 feet over average bed level of river; it is assumed to be the latter for the last three entries in the table.

(*c*) That it is advisable to have water level in the river at least 1·5 feet over that in the canal.

(*d*) That balancing depth will be about 4·7 which would be the case for a discharge of 4,000 cusecs, bed width of 108, depth of 9 feet, free board of 3 feet, and banks of 23 and 15 feet crest width on the left and right sides respectively.

To obviate risk of silting the slope of the contour and of canal bed may be 1 in 5,714.

18. In considering what expenditure is warrantable on an anicut at this site it may be borne in mind that considerable expenditure would be necessary in adapting the regulators at the Grand Anicut and also at the bridge 3 miles further up the Cauvery, as well as liability to very undesirable shoaling up-stream, and that an anicut at or near the head of the Wyakondan on a sandy bed would be even more costly.

19. *Length of channel from Katali offtake.*—This channel by taking out much further up the Cauvery would at first sight appear to result in a much longer canal than would be needed from the Grand Anicut offtake; however a large part of the latter is required in encircling the high ground while the former would come more directly on to the top of it.

20. *Preliminary report.*—If the Katali site is found suitable for an anicut founded on rock the sloping contour as suggested in paragraph 17 *supra* may be run. It may then, I would suggest, be roughed out on approximate data what the cost of the various alternatives would be whether they are to be productive and which is on the whole the best and safest one to carry out. A preliminary report may then be sent for the information of Government of India, but further survey operations on the line considered best need not be suspended, provided the Local Government is of opinion that there is no reasonable doubt as to the most suitable project to adopt and that it will prove productive.

21. Since the project is only likely to meet the conditions of a productive one with a very small margin, I would venture to suggest that the provisions of Public Works Department Code, Volume II, paragraph 2135 (*a*), may be borne in mind in preparing the estimate, and selecting the tracts to be irrigated.

22. *Concluding remark.*—I had the advantage of being accompanied throughout my tour by Mr. H. E. Clerk, Officiating Chief Engineer, and I wish to thankfully acknowledge the great assistance which I received from this officer. Mr. R. F. Stoney, Executive Engineer, also accompanied me throughout the portion of the work surveyed, and afforded me ever ready information on all matters connected with his work.

III

Note on the Cauvery Reservoir Project, Madras Presidency, by Mr. J. Benton, C.I.E., Inspector-General of Irrigation, dated 15*th January* 1910.

I.—Administrative.

Alternative schemes.—These were previously reduced to the following :—

I. Grant Anicut project comprising the following —

(i) Construction of a high masonry storage dam on the Cauvery river at Metur about 26 miles upstream of Bhavani.

(ii) Execution of certain works to admit of extension of irrigation in the Cauvery delta.

(iii) A new canal with offtake above the Grand Anicut and proceeding in an easterly direction as far as Tanjore which is reached in the 26th mile, and thence in a southerly direction as far as the Narasinga Cauvery river, the total length being about 85 miles.

II. Kattalai project comprising the following :—

(i) Storage work as in I (i) *supra*.

(ii) Delta extensions as in I (ii) *supra*.

(iii) A new canal taking out of the Cauvery at Kattalai on the right bank, and proceeding down the valley in an easterly direction to the 77th mile from whence it is aligned in a southerly direction to the Agniar river, the total length being about 98 miles.

2. *Areas of irrigation.*—The areas of irrigation under the two schemes are estimated by the Superintending Engineer to be as follows :—

Areas in acres.

Particulars.	Kattalai project.		Upper Cauvery project.	
	Single crop.	Double crop.	Single crop.	Double crop.
Kattalai canal	329,000	91,000	..	..
Grand Anicut	..	..	202,000	56,000
Vadavar extension	52,000	15,000	52,000	15,000
Perambar block	1,000	4,000	1,000	4,000
Existing cultivation with raising of 70,000 acres from single to double crop	838,000	160,000	838,000	160,000
Total	1,220,000	270,000	1,093,000	235,000
Deduct existing area	908,000	90,000	908,000	90,000
Net increase	312,000	180,000	185,000	145,000
	492,000		330,000	
Difference	162,000			

An extra area of 162,000 acres at a gross revenue of Rs. 5, and net revenue of Rs. 4 per acre would warrant the expenditure of 162,000 acres × Rs. 4 × $\frac{100}{4}$ = Rs. 1,62,00,000.

The difference in expenditure is likely to be about Rs. 1,00,00,000 according to the preliminary estimates, so that the increase of area would appear to warrant the larger scheme being preferred to the smaller one ; however the sufficiency of the water-supply is the ruling condition.

3. *Proportion of irrigation.*—In the Grand Anicut project the existing tank-bed and wet cultivation have been deducted from the gross area, and 70 per cent of the balance has been assumed to be irrigable ; this procedure appears to be safe, but more accurate figures will presumably be available when the Revenue Officer has dealt with the case.

4. *Existing irrigation.*—This is as follows :—

(i) Numerous small tanks, and a considerable area of wet cultivation throughout the tracts to be irrigated by both projects.

(ii) An extensive belt of irrigation from the existing Wyacondan canal along the Cauvery river, and which largely reduces the possible area of new irrigation in the first 77 miles of the Kattalai project.

Full particulars of (i) *supra* will be required for the project selected for execution, while the area (ii) will be entirely excluded from the commanded area of the new canal.

5. *Duty of water.*—A duty of 70 acres per cusec calculated on the maximum supply entering the new canal, is to be adopted, and this appears suitable; this duty contains an allowance for the maximum exceeding the average supply.

6. *Available supply.*—As explained in my note, dated 19th March 1909, there was considerable uncertainty as to the amount of the available supply, and as to its sufficiency for the more comprehensive Kattalai project. In order to settle this question continuous observations of the discharge of the Cauvery river were made—

(i) at a site about two miles upstream of Bhavani, the discharges being referred to the Bhavani bridge gauge where the bed is of rock,

(ii) and at the site of the upper anicut.

The Bhavani gauge record goes back for 18 years, and the information procured during 1909 serves to admit of the discharges being estimated day by day for this period, and of the working of the projects I and II being forecasted for this period on the supposition that the works were then in existence. This investigation was a complicated one owing to the entry of the Bhavani and Amaravati rivers between Bhavani bridge and the upper anicut; a further complication was caused by the discharges at the upper anicut depending partly on the gauge reading, and partly on the state of the river-bed which is liable to be scoured out by rising floods, and to be silted up by subsiding ones. Colonel W. M. Ellis, R.E., Superintending Engineer, has prepared draw-off tables for the Metur reservoir for 18 years, and for both the Grand Anicut and Kattalai projects. I examined these draw-off tables, and I found that there would be insufficient water for the larger or Kattalai project in 4 out of 18 years, even when the whole of the flood discharge of the river is fully utilized.

7. *Working of the different projects.*—The Chief Engineer kindly furnished me with table I given in Appendix A to this note which shows the estimated areas of annual irrigation and revenues corresponding to full supply for storage of 70,000 and 90,000 mills.c.ft. both for

the Kattalai and Grand Anicut projects; this officer also furnished me with a table showing the shortage in areas and revenue for each year for the period 1890–1891 to 1908–1909 both inclusive, as compared with the full areas, and form it I have prepared table II, Appendix A, to show the corresponding results in the positive form of percentages of full performance indicated by table I. The full areas for the different periods are given in the heading of table II, and the figures opposite the 19 years are the percentages of the full area which are estimated to be irrigable in each year. In the first period given in the table the cropping from June to December is given; and in the second period that from December to end of February. With regard to the entries at the foot of the table—the average percentages are those of the figures above—the differences are the shortages of those averages from 100 per cent and the corresponding percentages of shortages of actual compared with full revenues. It has been assumed that revenue is exactly proportional to water-supply which errs on the side of safety, since no cognisance is taken of the fact that seasons of short supply are ones of economical use of water and abnormally high duties. The entries in the last line at the foot of the table give the aggregate shortages of revenue for the two irrigating periods comprised in each year, and these also err on the side of safety for the reason just given. This table goes to show as follows:—

(i) At long intervals there are years of short supply in the Cauvery when the flow in the first period as defined above is short, while that for the second period is still more so; the years 1899–1900, 1904–1905, and 1895–1896, are cases in point. The shortages of these years told heavily on the existing irrigation in the past, but the storage of a large supply of water in future will greatly benefit existing irrigation, while serving to give fair results for proposed extensions.

(ii) Apart from these unfavourable years of infrequent occurrence which affect both periods, there is a liability in others of infrequent occurrence for the second period only to be appreciably affected by short supply; the years 1894-1895 and 1908–1909 are cases in point. The effect of the storage work will be highly beneficial to existing irrigation, while it is an absolute necessity for extensions.

Even when these conditions are taken into account it will be seen by the entries given in the last two lines in the table that the smaller reservoir will afford highly satisfactory results for the Grand Anicut project, and the larger one for this or the Kattalai project. The shortages would almost disappear in the average results owing to the high duties which would obtain in years of short supply, the increased duties due to future improvements in working, and to irrigation being effected in favourable years in excess of the normal areas given in table I, appendix A.

8. *Storage capacity required.*—The following goes to show that the storage should be over 70,000 mills. c. ft. and that 80,000 to 90,000 may be provided :—

(i) *Kattalai project*—

For 70,000 mills. c. ft.	shortage	4·6	lakhs rupees.
„ 90,000	„	„	3·2	„
Difference	„	„	1·4	„

This would warrant an extra expenditure on the larger scheme of 25 × 1·4 = 34 lakhs, while the roughly estimated extra expenditure in providing the larger amount of storage is 30 lakhs.

(ii) *Grand Anicut project*—

For 70,000 mills. c. ft.	shortage	2·4	lakhs rupees.
„ 90,000	„	„	1·4	„
Difference	„	„	1·0	„

This would warrant an extra expenditure of 25 × 1·0 = 25 lakhs, while the extra cost as above stated will be 30 lakhs. For this project it appears unwarrantable to expend more than about 25 lakhs in increasing the storage of the 70,000 mills. c. ft. reservoir. It may suffice to increase the capacity to 80,000 mills. c. ft. but this may be investigated by the local officers. It will be possible I understand to increase the extent of second crop in the delta beyond the 235,000 acres shown in the table, paragraph 2 *supra* and 10,000 acres more at a gross revenue of Rs. 3 and net revenue of Rs. 2 per acre would suffice to meet the interest charges on the additional Rs. 5,00,000.

9. Whichever project is adopted the storage capacity should exceed 70,000, but whether it should be about 80,000 or 85,000 mills. c. ft. for the Grand Anicut project is a subject for further consideration; attention may now be confined to selection between the Kattalai and Grand Anicut projects when the storage capacity is made 90,000 mills. c. ft.

10. *Opinion of Chief Engineer.*—This is given in Appendix B to this note. The existing irrigation will benefit by the new work but little extra revenue can be realized until expiry of the existing settlement in 1922–1923; on the other hand the financial results by which the

project has to be gauged are for the period, from opening of the new works until 10 years after completion, or say from 1918 to 1928, so that full revenues for improvement in the delta can only be got for about 6 out of the 10 years which have to be considered.

11. *Preference for the Grand Anicut project.*—Without working out both projects in full detail it is impossible to say exactly which one will give the best return on the capital expenditure; however the preliminary estimates show that the return will be almost exactly the same. I advise adoption of the Grand Anicut scheme for the following reasons :—

(*a*) For the Kattalai project remissions of 17 per cent and 26 per cent in first period and of from 41 per cent to 90 per cent in six years in the second period with an average of 16·5 per cent for the latter in 18 years are very undesirable.

(*b*) For the Grand Anicut project the remission are moderate and under the conditions mentioned in paragraph 7 *supra* they would be inappreciable.

(*c*) Liability to remission would be a great barrier to enhancement of the existing rates in the wide area of about 1,000,000 acres of irrigation in the delta.

(*d*) For the various other reasons given in Appendix B to this note which shows the Chief Engineer's opinions as to the project which should be accepted.

12. *Dam site.*—The proposed site at Metur, 36 miles up-stream from Bhavani, is a very good one as regards character of rock in the river-bed, and the facilities for surplusing. Materials for construction will also be procurable within a short distance. Several sites have been surveyed, and excellent surveys have been prepared. The quantities of masonry work for the different sites may be tabulated for the sake of comparison. The question of supply of lime by narrow gauge lines calls for investigation; and the quality of the lime should be determined.

13. The proposals for surplusing are as follows :—

(i) Through a limited number of deep sluices; these are chiefly required for supply purposes after construction.

(ii) Over the dam during construction.

(iii) Eventually over an adjacent shoulder on the left bank, and also over the right hand end of the weir.

These proposals appear to be generally suitable.

14. *Project for new canal.*—I would venture to recommend as follows :—

(i) Measures being taken for the estimate of revenue being procured as early as possible, so that the project may not be delayed for this information.

(ii) The adoption of measures which will serve to admit of the project being submitted to the Madras Government within eight months from this date or earlier; and of submission to Government of India fully printed one or one and a half months later, or say by the end of October 1910.

II.—Technical.

15. *Dam mainly of rubble masonry.*—In the high dams of the Bombay Presidency close jointed rubble masonry is used in the following parts of the work :—

(i) Throughout all the deeper parts face to face.

(ii) On the front and the rear faces for a certain thickness.

(iii) In the upper part.

I understand that concrete is only used where the stress does not exceed a certain safe limit of intensity which as far as I recollect is 60 lb. per square inch. In the rubble masonry the stones are carefully fitted, the mortar only amounting to about 24 c. feet per 100 c. feet masonry as far as I recollect, while the jointing is so close that water used in dampening the work will remain in pools for days on the unfinished work. I recommend this procedure for consideration, and would suggest inspection of the Bombay works on the Gōdāvari. Since there were no plans of the masonry works when I visited the site I am unable to offer further remarks.

16. *Field work and designing.*—As the various reaches are set out, it is hoped that designing of canal and of masonry works can proceed apace without waiting for the completion of the survey of the whole of the main canal.

17. *Longitudinal section.*—I would suggest that levels may be observed at 500 feet intervals on flat ground, on rough ground at 100 feet intervals, and in crossing drainages at closer intervals, so as to give the figure of the channel. All maps have to be on the inch system but longitudinal sections will be more serviceable and less troublesome to prepare if the decimal system is adopted of having 5,000 miles, no mention being made of furlongs anywhere in the estimates. I would urge that the longitudinal section should not be converted into an irregular estimate for excavation and land quantities since all such information can be more conveniently rendered elsewhere. The particulars given in Appendix C to this note appear to be all that are required for project purposes on longitudinal sections and to add more than is really required is to delay work in drawing offices, and to add to the labours of scrutinizing officers.

18. *Design of masonry works.*—I hoped that typical plans of bridges and drainage culverts might be available for discussion, but this has not been possible. I wish to remark as follows :—

(i) Elsewhere bridges are usually provided at an average rate of one cart bridge and one foot bridge per five miles of large canal ; the works are located where they can be of most use to the public in serving existing roads, towns, and villages. Wide cart bridges are considered unwarrantable when the traffic is light. Circumstances in this tract may call for departures from the practice as just explained.

(ii) With regard to culverts hydraulic gradients should be drawn for the terminals, and if possible 4 feet of dry earth given over the toe. The liability of overhead arches and of flat floors to blow up must be guarded against. Close floors should be adopted until the velocity will be below six feet per second : Weep holes may be provided in side walls and floors and blowing up guarded against. The protection up and down stream may be on a liberal scale, and should cover all parts of the bed exposed to higher velocities than the soil will safely withstand. Side slope protection is required to a greater extent than for the bed All bed and slope protection should have a soling course to obviate eddies causing settlement. At least three feet of the barrels should be above bed level down stream, so that silting up by small floods may not occur to a dangerous extent. Longitudinal sections of drainages for some distance on each side of the crossing are required and these should show M.F.L. and cutting down of out fall if proposed. It will often be desirable to lay puddle over the works so as to lessen percolation and risk of floors blowing up. Dr. Unwin's formula may be used in calculating the discharging capacity of syphons if any are proposed and in all such works where the arches are liable to blow up the hydraulic gradients should be drawn on the longitudinal section.

(iii) The canal is aligned across the drainages ; and it is advisable to prepare a general map of drainage catchment areas, and then to decide on how the run-off from each part is to be provided for.

(iv) I would advise that arrangements may be made for ascertaining the maximum floods which pass down the principal drainages from now until the masonry works are put in hand. Levels of the flood water may be ascertained at suitable distances apart for the discharge to be calculated by Kutter's formula. Attempts to gauge floods by velocity observations are not likely to be successful, because the floods usually last for a very short time and may pass at night.

(v) Liberal assumptions as to run-offs should be made as the general tendency elsewhere is to underestimate these.

19. *Rates.*—Past, present, and probable future rates for the more important classes of work should be made the subject of very careful study ; it has to be borne in mind that the execution of extensive works is liable to cause an enhancement of the local rates for small works, and that it is very unsafe to draw any conclusions from the latter. It may be advisable to have two sets of abstracts of cost as follows :—

First set.—Based on rates rather in advance of the current ones and which ought to see the works through to the extent of 60 or 70 per cent. These rates would appear in the detailed estimates.

Second set.—The general abstract of the estimate submitted for sanction may have the amounts arrived at above under the different account heads enhanced by appropriate percentages for each class of work, so as to cover the unforeseen. The amounts of this enhanced estimate are those which would be used in the financial forms, and for which sanction would be procured. Project estimates are prepared for Government and their officers and I would venture to suggest that reference by contractors to rates quoted therein should not be tolerated.

20. *Concluding remarks.*—I had the advantage of being accompanied in my tour to Metur and Kattalai in the Cauvery Valley by Mr. C. A. Smith, Chief Engineer for Irrigation, and Colonel W. M. Ellis, R.E., Superintending Engineer; these officers afforded me every assistance both in inspections and subsequently in examining the project proposals. The Cauvery project appears to me to be a prefectly feasible one, and subject to what the revenue forecasts may show, it appears to me to be a sound one.

APPENDIX II.

REVENUE PAPERS.

I

G.O. No. 3347, Revenue, dated 15th October 1910.

READ—the following papers :—

I

Letter from E. H. WALLACE, Esq., M.A., I.C.S., Special Revenue Officer, Cauvery Reservoir Project, Madras, to the Secretary to Government, Revenue Department (through the Secretary to the Commissioner of Revenue Settlement, Survey, Land Records and Agriculture), dated the 31st May 1910, No. D. 45.

With reference to G.O. No. 25, Public, dated 10th January 1910, placing me on special duty in connexion with the revenue investigation of the Cauvery Reservoir Project, I have the honour to submit for the orders of Government my report on the revenue aspect of the modified Cauvery Reservoir Project.

2. *Outline of scheme.*—The scheme, as now outlined, involves (*a*) the construction of a reservoir in the Upper Cauvery valley, with dam at Metur, about 26 miles above Bhavani, with a capacity of from 80,000 to 90,000 millions cubic feet, (*b*) the construction of a main irrigation channel with its necessary distributaries about 88 miles in length taking off from the right bank of the Vennar at about $\frac{1}{4}$ mile below the Grand Anicut, proceeding almost due east as far as Tanjore town, and then almost due south, through Tanjore and Pattukkottai taluks finally discharging into the Narasinga Cauvery, a little south of Arantangi ; (*c*) improvements to the Vadavar channel. The area commanded by the main channel is roughly all the area north and east of itself up to the border of present delta irrigation, in Tanjore and Mannargudi taluks, and up to the east border of Pattukkottai taluk. A small area in Pudukkottai State, on the west border of Pattukkottai taluk, is also commanded. It is not at present contemplated to utilise the water in Tiruturaipundi taluk. The improvements to the existing Vadavar river will increase irrigation therefrom to the extent roughly, of $\frac{1}{5}$ of the whole new area which the Public Works Department expect to irrigate, the remaining $\frac{4}{5}$ being irrigated by the main canal from the Grand Anicut.

3. I have made no distinction in my returns, between the new irrigation under Vadavar and that under the main canal. No distinction has been made by the Public Works Department in their maps of commanded area, and the whole new area, may, for brevity's sake, be regarded as one block. The Public Works Department estimate of the extent of the new irrigation in this block for which they will have water is 330,000 acres first crop and 75,000 acres second crop.

4. *Physical features of commanded area.*—The country commanded by the scheme is open, healthy and offers no difficulties for irrigation. It slopes very gradually from the Vallam ridge towards the sea, appearing to the eye as uniformly flat, without marked undulations. The soil is generally light, friable and well-suited for water. No terracing or systematic levelling will be required. All that will be wanted are the usual low bunds to retain the water. The adaptation of the land for irrigation will entail no appreciable expense on the ryot. I anticipate that water will be freely taken throughout the area and irrigation expand quickly and systematically. The commanded area is not at present thickly populated, but fresh

irrigation is sure to attract a large population from the already crowded delta tracts and neighbouring districts. I cannot imagine any tract of country more favourably situated or suited for irrigation.

5. *Scope of present investigation.*—Before entering into details about the area commanded I must solicit a reference to my former report, written when I was investigating the original scheme of this project in 1905. It will be found embodied in Government letter No. 597 I, dated 1st June 1906. The areas in the taluks of Tanjore (including Perambur block), Mannārgudi and Pattukkōttai, shown as commanded then are also part of the area commanded under the present scheme. The east and west side channels and the Tiruturaipūndi block of the old scheme have been abandoned. In my present report I have not made any fresh investigation worth speaking of regarding the old areas in the Tanjore and Mannārgudi taluks as they were largely Government village areas and the figures given for them previously were reliable. I have then embodied in my present returns my old figures for those areas with a few alterations. The chief alteration is the exclusion of all II class delta area, much of which was included before. This was done on the advice of the Special Superintending Engineer and will account for a decrease in the wet area commanded. Other alterations are due to previous clerical errors or misprints in figures and to the fact that some villages and inams previously given as partly commanded are now wholly commanded.

6. In the case of the old Pāttukkōttai area, however, which is mostly zamin and shrotriyam, I found that the figures gathered by me in 1905 certainly justified the caution expressed by me in paragraph 73 of my report of 1905. I have come to the conclusion that the figures of occupied areas given me then were not reliable and safe to proceed upon, and I have discarded wholly my 1905 figures for Pattukkōttai, for both Government and private areas. I have done the whole work for that taluk afresh.

7. *Registers and returns.*—I have, in my returns, divided the area commanded, into "Government", "minor inam" and "whole inam" (including shrotriyam), "chattram elaka" and "zamin". For each of the three taluks, Tanjore, Mannārgudi and Pattukkōttai, I have compiled for the Government area a consolidated villagewar return marked A showing the details of the commanded areas. A register similar to A called A_1 with necessary alterations has been compiled for the villages of Pudukkōttai State. For the details of the minor inams, whole inam, chattram and zamin commanded areas, I have had compiled for each taluk a register marked D, with one enclosure S to the Pattukkōttai register, and a register D_1 for Pudukkōttai State.

8. The registers called A have been compiled from detailed rough registers of Government area in each village. These give fieldwar details of the commanded and uncommanded areas according to the Public Works Department colour-washed maps, where the village is only partly commanded. It was unnecessary to write them up in detail in the case of wholly commanded villages, as they would have been mere reproductions of the karnams' adangals. In such cases only such information as I wanted for my other registers, e.g., extent of natham, kinds and extent of other porambokes, classification of soils and irrigation sources, etc., was noted.

9. I will shortly describe the various registers drawn up and herewith submitted. The A registers shown in column 6 the total Government area in a village (excluding all inams and zamin and shrotriyam lands). Columns 7 to 12 show how much of this is commanded and its nature, occupied, unoccupied or poramboke. Columns 13 to 18 show the balance, if any, of land uncommanded. The classes of wet lands are shown in a footnote and also the grouping of dry lands. Columns 13 to 18 are omitted in the Mannārgudi A register, as all villages but one (No. 126) are wholly commanded. A_1 (for Pudukkōttai State) is on the same lines, the "Government" area in this case being "State" area.

10. The B registers contain analysis of the Government poramboke areas in Government villages commanded and uncommanded shown in columns 11 and 17 of the A registers. I have had these compiled for the old and new areas. They are chiefly useful to show whether there is any useless poramboke commanded which might be turned into irrigable land, and for showing what open common land there is for the use of the villagers in each village.

11. The C registers give statements of natham poramboke in Government villages only, compiled with a view to determining, if possible, how much land ought to be reserved and irrigation therein prohibited, in order to provide land for the extension of natham which will be required in the future and for an area of dry belt round it for the purpose of sanitation and health. It has been prepared for all Government villages commanded.

12. The D registers show in columns 4 and 5 the details of the occupied area commanded in the inam and zamin areas.

13. *Porambokes.*—With reference to the existing poramboke area in Government villages, I may say at once that I do not propose that any of it at all should be transferred to wet land and irrigated. In 1905, it was proposed that tank-bed areas should be transferred to occupation and sold for wet land, but now I am instructed that they should remain at present as they are. So, while showing them separately in column 5 of the B registers, in case the areas of tank-bed might be subsequently required, I have excluded them as well as all other porambokes, from my *irrigable* area.

14. A glance at the B registers will show that all the porambokes are useful. Road and railway, natham and channel, obviously cannot be available for irrigation, nor are the areas set apart for them excessive. I have refused also to convert "grazing ground" and "forest" to irrigable land. The experience of the existing delta is sufficient to impress on me the need of retaining for grazing and other communal purposes, all open ground at the disposal of the Government. It might be argued that if the so-called grazing ground was fit for grazing, it would have been taken on patta long ago But even if it is at present unfit for grazing, the introduction of water all round the neighbourhood may improve it. As regards the "forest" areas, they are, so far as I have seen them, mostly sand and casuarinas. The District Forest Officer (Trichinopoly *cum* Tanjore), whom I consulted about "forest" areas both in the new and old areas, reports that he "does not think" they contain any valuable timber. In any case I think it essential that they should be reserved for grazing and fuel supply and as useful open dry spaces, and urge that they be not converted into irrigable land unless and until they become water logged from the surrounding irrigation and useless for any other purpose. The total "Reserve Forest" commanded is not large, only about 3,700 acres.

15. *Grazing ground.*—From the B registers it is obvious that the extent of grazing ground poramboke and reserved forest in most villages is by no means sufficient for their grazing requirements. In only 12 villages out of the whole 155 Government villages commanded is there any grazing ground poramboke, and very little at that, and in only 26 villages is there any reserved forest. It is obvious that, if possible, more land should, at least in the meantime, be reserved for grazing purposes. The only land, excluding porambokes, which is at the disposal of Government for this purpose is the unoccupied dry land. The occupied wet land is presumably low-lying and liable to be water-logged.

16. In my report of 1905, I recommended (paragraph 94) that 10 per cent of the assessed land in every village should be retained as "dry" to serve for grazing purposes and for extension of natham and a dry belt round the village. In that Government remarks, G.O. No. 2, Revenue, dated 2nd January 1906, that "the land must be used to the best purpose and the provision of grazing ground left to be governed by the general law of supply and demand." Lately, however, in the case of the Kistna Project, Government have remarked, G.O. No. 1682, Revenue, dated 24th June 1909, that they consider that "even in villages where the land will all be irrigable, it will be well to set apart a definite area of unoccupied land for grazing," and that "ample provision should be made for grazing." I certainly consider it most advisable that some provision should be made for reservation of land (which must be unoccupied dry land), for grazing purposes. The latter Government Order remarks that this area required "will depend on the total acreage of irrigable land and the total area that will hereafter be under cultivation, the extent that can be ploughed by a pair of oxen, the consequent population of agricultural cattle and the extent of grazing ground required for it, taking into consideration the available resources of grazing in forest reserves, etc." After much consideration, I have been unable to evolve any practical method of determining on these lines the extent of grazing

ground required in a village, and I confess myself unable to determine any arithmetical relation between the number of ploughing cattle in a village and the extent of grazing ground they require It is no use attempting to argue from existing conditions. Cattle live or die whether the grazing is superabundant or insufficient, and I do not believe that there is at present any constant relation between the number of cattle in a village and the extent of grazing ground available. Nor is there I am sure, any constant relation between the number of plough-cattle in a village and the area to be ploughed. Cattle are lent from a village with a late ploughing season to one with an earlier one and *vice versa*. Further the Government Order takes no account of the existence of milch cows and calves, buffaloes, sheep and goats, which likewise require grazing ground. Hence I find it quite impracticable to attempt to discover any working relation between the number of ploughing animals in a village and the extent of grazing ground required.

17. I have therefore adopted a purely arbitrary plan, and have endeavoured to reserve where possible 150 acres in all villages of over 3,000 acres (Government area), 100 acres in all villages between 2,000 and 3,000 acres and 75 acres in all villages below 2,000 acres. Of course in many villages that acreage is not obtainable and thus I have simply had to be consent with the area of dry unoccupied land available. The above plan applies only to wholly commanded villages or to villages so largely commanded that the uncommanded dry area is less than 150 acres. Where sufficient reserve forest or grazing ground poramboke is available in a village, I have not reserved any further land for grazing ground. The areas so reserved are noted in the "Remarks" column of the A registers and the total area for each taluk is given in a footnote to those registers. The areas noted in the Remarks column ought to be for the present at least retained as dry—"dry" and not assigned.

18. *Natham extensions.*—The C registers which are for Government villages only are compiled in order to carry out, as far as might be practicable, the spirit of Board's Proceedings, Mis. No. 3293, dated 14th October 1909, and G.O. No. 2470, Revenue, dated 7th September 1909. I have proceeded on the following rough principle :—In wholly commanded villages, I take from A registers the whole occupied area which, as I anticipate (see paragraph 26), will practically all be wet. I calculate the requirements of a village at 10 cents natham for every 5 acres wet. Then if that area calculated exceeds the existing natham and assessed jari, I strike the balance still required and enter it in column 6. If no additional area is required, column 6 is left blank. Then in column 7 I enter the fields out of which the extended area might be provided. In the case of partly commanded villages, I have as a rule (though there are exceptions noted in the Remarks column) presumed that the whole of the required extension will be to those pieces of natham which are already within the commanded area. [*Note.*—It must be remembered that column 5 of C only gives the natham area commanded. This will correspond with the whole natham area in the case of wholly commanded villages (which comprises practically all the old area). In the case of partly commanded villages, the existing natham will be found by adding columns 3 and 12 of register B.]

19. I must point out that my calculations are useful mainly to get at the total area which ought to be reserved out of commanded area for extension of natham, and I do not hope that the naming of certain fields in column 7 for reservation will be of very much assistance in localising where that extension should be. It was quite impracticable to localise such extension without an intimate and detailed inspection of the natham of each village and its hamlets. Such work myself and my staff could not possibly undertake and it will require a special staff. Villages exist with 40 and 32 different pieces of natham in 24 different fields Villages with over ten pieces of natham are the rule and not the exception. In fact, the average number of pieces of natham to a village works out to about sixteen. There are 155 villages and therefore about 2,480 pieces of natham. Each one of these ought to be inspected to find out whether extension of it is really required or not. In some villages natham is loosely made to cover river-bed, tank-bed, etc. In other villages there is no recognised natham at all, and some suitable place will have to be selected. Only a special staff would cope with this work and it will take them some months to inspect 155 villages thoroughly.

20. While I have provided for extensions generally of the main natham and bigger hamlets in proportion to their present sizes, detailed inspection may show that it is the smaller hamlets that require extension and not the bigger ones, or that a bigger one or a smaller one requires more than its proportion to the others.

21. The land on which the village-sites will have to extend is at present mainly occupied dry land. I am doubtful if Government will consent to the wholesale acquisition which would be required to carry out a complete scheme of such extensions, and if it would, such a scheme again will have to be carefully planned by a special staff with reference to the requirements of each piece of natham and the preferences of each community and caste of house-holders.

22. I thought, however, it might be useful to indicate the survey numbers of fields surrounding the main nathams, out of which extensions might reasonably be provided, and if Government sees fit, irrigation may in the mean time be prohibited on those areas in those fields mentioned in column 7 of registers C. The total of column 7 will give us roughly the area on which irrigation should be prohibited.

23. It seemed to me also impracticable to localise the 50 yards dry belt round village and hamlet sides, as indicated in G.O. No. 2470, Revenue, dated 7th September 1909 (in the case of the Kistna Project). The Government Order prescribes a dry zone of 50 yards round all villages and hamlets. It does not define "hamlets" which I presume includes all groups of houses. The amount of work involved in localising such a belt will be very considerable and will also require a special staff. A detailed inspection of 2,480 groups of houses would be necessary. In the case of villages with many different pieces of natham, it must be decided whether a 50 yards belt is to be supplied to each. Further, the localisation of the belt and its consequent area depend on whether the above extensions of natham are approved aad carried through by acquisition and on a detailed consideration of the question, whether the existing pieces of natham are being wholly utilised or not. Finally, even if the belts are localised and irrigation in them prohibited, I do not know how Government intends to control the owners of the fields who will do their best by lowering their land until it becomes waterlogged by percolation to render it unfit for dry cultivation in the hope of getting it converted to wet, and thus frustrate its use as a belt of dry cultivation.

24. I have, however, worked out theoretically a kind of average area that will be required for such a dry belt. On taking twenty villages at random, I find the average area of each piece of natham to be about $1\frac{1}{2}$ acres. A simple calculation will show that a 50 yards belt round a circle whose area is $1\frac{1}{2}$ acres will measure very approximately 4·57 acres, or roughly three times the area it encircles. I therefore calculate that the amount of land that should be reserved for dry belt is three times the sum of present commanded natham and future extension, i.e., $3 \times$ (column 5 + column 7 of *C*). This is probably an overestimate, as extensions will be added to existing blocks and so increase the average area of those blocks, without increasing the number of them, and as the proportion of belt to the area it encircles diminishes as the encircled area grows larger. But the figures arrived at will be near enough for practical purposes and it is well to err on the safe side.

25. The total area to be reserved for "dry" for natham purposes is therefore $3 \times$ (column 5 + column 7 of *C*) for dry belt + column 7 of *C* for extension, which may be put into symbols as 3 v + 4 vii. The extent which thus amounts to for each taluk is given as a note to the C registers, and it must be remembered that practically the whole of this has to be provided out of present occupied dry land.

26. *Irrigable area.*—I come now to consider what extent of the Government area commanded will be available for irrigation. None of the poramboke area in column 11 of the A registers will be available. The whole of the Government wet area (occupied and unoccupied)—columns 7 and 8 of *A*—will, we may confidently expect, take water. The occupied dry area (column 9) has to be diminished by the extent required for extension of natham and dry belt and the unoccupied dry area (column 10) by the extent required for grazing ground reservation.

Practically the whole of the balance will, I anticipate, take water. The resultant figures are given in detail for each taluk in the returns called E and are consolidated in the general return F.

27. The extent of minor inam commanded will be found in the three D registers. Columns 4 and 5 show the respective "wet" and "dry" areas. I expect all this area to take water, the present sources of supply to "wet" minor inam being poor. A small area of minor inams within "chattram" villages is shown in the Pattukkōttai D_1 register, and I expect it will take water. The minor inam figures are entered in the returns E for each taluk and consolidated in F.

28. As regards whole inam and shrotriyam areas, figures are given in the D registers. For these, fairly reliable statistics of occupation were gathered from the local karnams and checked where possible by the inam B register. In the case of partly commanded whole inams and shrotriyams in Pattukkōttai taluk, the uncommanded area was estimated roughly by map measurement by the Special Executive Engineer. My estimation of the area that will take water appears in the E returns. I have no doubt that most of the commanded occupied land, particularly the wet land, will take water. The existing sources expect no supply at present until the end of October.

29. As regards chattram villages, which lie wholly in Pattukkōttai taluk and are under the management of the District Board, I have to distinguish between those for which maps were available and those for which they were not available. The former have been dealt with on the same lines as the whole inam areas and find place in the D register of Pattukkōttai. The latter have been dealt with on the same lines as "zamin" areas and find place in the statement S enclosed with Pattukkōttai D register. My estimates for the former will be found in return E for Pattukkōttai. They stand in the same position as the whole inam areas. To this irrigable "chattram" area has to be added an extent of 4,000 acres swamp (see paragraph 79 of my 1905 report).

30. The zamin and unmapped chattram areas are shown in S and have been arrived at as follows:—No maps at all for this area being available, I obtained from the Deputy Director of Survey the total areas as per circuit maps of these various zamins, then obtained from the Special Executive Engineer an estimated extent by circuit map measurement of the total areas commanded, the total wet areas, tank-beds and river, which items could be, with fair accuracy, measured, on the circuit maps. The balance shown in the last column includes "dry" land and a certain amount of poramboke. I think it reasonable to assume that the occupied wet area has not increased appreciably since the circuit maps were drawn up, and any one who knows the country and its irrigation sources must agree with me.

31. In order to arrive at some fairly accurate figure for the occupied dry area, I take the analogy of the Government villages of Pattukkōttai taluk, to which in soil, general features and the irrigation facilities, these zamin areas are very like. A glance at the Pattukkōttai A register will show that in the average Government villages, about 22 per cent of the village is poramboke. It will probably be not far wrong to assume that in the average zamin village about 25 per cent of the village is poramboke. Now enclosure S gives a total commanded area of about 90,000 acres. If 25 per cent of this is poramboke, then 67,500 acres is cultivable land. Another glance at the Pattukkōttai A register will show that on the average about 10 per cent of the wet land is unoccupied and 11 per cent of the dry land. The proportions of unoccupied to occupied land will be higher in the zamin tracts and I assume them to be 15 per cent and 20 per cent respectively. Now of the 67,500 acres of cultivable land, 21,000 acres is "wet" and therefore 46,500 "dry". Working out the proportions we get 17,850 acres "occupied wet" and 43,200 "occupied dry." I anticipate that almost the whole of the occupied wet will be irrigated and that almost all the unoccupied wet will be taken up as being easily rendered fit for irrigation and estimate the final "zamin wet" area at 20,000 acres. Out of the "occupied dry" area, I anticipate that 30,000 acres will probably take water. I do not expect the unoccupied dry area to be irrigated for a long time to come. I have entered my figures accordingly in returns E and F.

32. Similar calculations for the small commanded zamin area in Tanjore taluk (shown also in S) will give 10,000 acres whole area commanded, 2,500 of this poramboke, and the balance 7,500 acres practically all "dry land". Of this 1,500

acres will be unoccupied, leaving 6,000 acres. I anticipate that 5,000 acres of this will take water. This area will lie along the line of the main canal. I accordingly enter this figure in Tanjore E return and in F.

33. I have calculated these zamin and chattram unoccupied areas in this theoretical manner because I found that I could obtain no statistics of occupation of land in these tracts that were the least reliable. The zamin tenants pay their rents in grain and no systematic accounts are kept. Certain returns are submitted to Government for the purpose of furnishing a basis for the calculation of the zamin village cess, but I found it useless to trust them. I might have made a rough survey of a few zamin villages, but considered that generalising from the figures of a few villages in one season of a particularly bad year would probably lead me still further astray. The time and staff at my disposal did not admit of any comprehensive survey of the zamin tracts which will have sooner or later to be made. Such a survey will occupy some years.

34. I know the tract of country well enough to say that I have no doubt that project water will be eagerly taken, and I am supported in that opinion by everyone whose opinion I have taken. The tanks are extremely inferior sources of irrigation, do not fill usually until November and then hold only one or two months' supply. The zamin tenant is not likely to refuse to take the project water offered to him in June from a certain and steady source, and for project water they will of course pay project rates. I understand that the Public Works Department idea is to utilise the zamin tanks and run the project water into them, as is done in the Periyar scheme and other zamin tanks will no doubt be filled with the drainage of Upper lands and tanks.

35. It is essential then, in fairness both to Government and the zamin tenant, that a reliable and systematic survey be made of present zamin occupation, classification of land, condition of, and supply in, irrigation sources and nature of crops raised. It is necessary that a careful and accurate return be compiled for a series of years on all these points, by a special staff which will have to work from May till February every year in order to provide Government with information on which to decide in future whether any particular tank or field has been drawing its water-supply from project water. It would be wise if this special staff is entertained the moment the project scheme is sanctioned and is continued every season until the project is in full working order. Statistics would then be available for some ten or twelve years. It is hopeless to attempt to depend on present zamin accounts or to call on the zamindars to maintain better ones, and if the Public Works Department intend to run their project water into the private sources of irrigation, the burden of proof that water taken to a field is project water will lie with Government, who must be armed with reasonable proof. Again such a survey for only two or three years would be almost wholly useless. There seems at present to be no systematic registry of fields as wet or dry, and as rent is a share of the crop it is hardly necessary. Fields called "dry" raise wet crops systematically and *vice versa*. Fields remain "wet" which have not raised a wet crop for ten or twenty years. Ayacuts remain ayacuts when their tanks are incapable of holding water for them. Any local collection of statistics will, I am sure, only be extremely misleading and entirely misrepresent the actual state of the tanks and fields. Government must be prepared to collect the necessary information by a staff of its own.

36. There remains the small area in Alangudi taluk of Pudukkōttai State. Return A_1 shows (columns 7 to 10) 8,362·90 acres State cultivable land commanded and return D_1 shows (columns 4 and 5) 633·04 acres inam commanded. I anticipate that this Alangudi area will freely take water as it lies just under the banks of the main channel, and estimate that 8,000 acres State area and 600 acres inam will take project water for a first crop, for which they will pay the project rate. These figures are entered in return E_1, and in general return F.

37. This concludes my remarks on the total extent of irrigable area available. The information for each taluk is given in the E and E_1 returns and is consolidated in return F. The total area available for first crop and likely to take a first crop is thus (column 10 of F) 333, 74 acres, of which area 121,270 acres is Government land, and 212,004 acres private land.

38. *Isolated blocks.*—Inasmuch as the total first crop area which the Public Works Department at present propose to irrigate is available in the four taluks, I have not proceeded to investigate one or two other areas to which my attention was drawn, and which are in the nature of isolated blocks in various parts of Tanjore district, nor have those been contoured in levels by the Public Works Department. In his inspection notes, embodied in G.O. No. 60 I., dated 5th March 1910, the Chief Engineer for Irrigation asked me to consider the possibility of bringing 2,000 acres waste land in Karapidagai village of Negapatam taluk, and any other similar blocks of waste land in the delta "under the project." He also says that the question of taking in the Tirutturaippundi block, embodied in 1905 scheme and at present in abeyance, should be reconsidered.

39. I have not however, after enquiry, been able to ascertain that any other such blocks which are irrigable from existing delta channels exist in these or other taluks. The Karapidagai block consists of two parts, 835 acres in Karapidagai Vadakusethi and 1,547 acres in Karapidagai Terkusethi, both of which blocks might be irrigated from the present Cauvery Kondanar Podu Vaikal from the Vellayar. Personally I deprecate converting any existing dry land in the delta to wet, until Government is thoroughly satisfied that such land is not wanted for grazing or other purposes.

40. *Second crop area.*—I take up next the question of on how much of this new area of 333,000 acres, second crop may be expected to be grown. This is independent of the question, whether an extension of second crop cultivation may be expected in the existing delta area. My opinion on this latter question has been given at length in my report of 1905, paragraphs 86 to 100, and I see no reason to alter it. I anticipated then as the result of steady supply from the reservoir, an increase of 70,000 acres in second crop cultivation in the present delta, distributed as follows :—

	ACS.
Tanjore	15,000
Kumbakōnam	25,000
Nannilam	20,000
Mayavaram	10,000

I remarked then later on (paragraph 114) that for this second crop area to be assured it was necessary that the water should be supplied as near 1st June as possible, and the new reservoir, as will be noted below, will ensure this. This increase of second crop in the delta itself may therefore be confidently anticipated. It was estimated then to produce an annual income of Rs. 2,60,000. I have accordingly included those figures in the general return F.

41. As for the second crop in the new area, when the Grand Anicut canal and the improvements to the Vadavar are carried out, I should expect that the new area commanded in Tanjore taluk will be similar in irrigation facilities to the Tanjore delta, that in Mannārgudi to the Kumbakōnam delta, and that in Pattukkōttai and Alangudi to the Nannilam delta, and should expect in these parts a similar proportion of second crop to first.

42. The average areas of first crop and second in the existing delta in these three taluks are approximately as follows (see return G) :—

	First crop. ACS.	Second crop. ACS.
Tanjore	86,000	26,000
Kumbakōnam	117,000	16,000
Nannilam	132,000	3,000

These will be increased with the spread of second crop irrigation in the delta (see paragraph 40 above) to

	First crop. ACS.	Second crop. ACS.
Tanjore	86,000	41,000
Kumbakōnam	117,000	41,000
Nannilam	132,000	23,000

second crop being thus 47·5 per cent in Tanjore, 35 per cent in Kumbakōnam and 17·4 per cent in Nannilam.

43. I think we may fairly expect similar percentages of second crop in the new area, i.e., 47·5 per cent in Tanjore new area, 35 per cent in Mannārgudi, and 17·4 per cent in Pattukkōttai and Alangudi. This gives us in Tanjore 47·5 per cent of 68,000 acres or 32,300 acres, in Mannārgudi 35 per cent of 48,000 or 16,800, and in Pattukkōttai and Alangudi 17·4 per cent of about 67,700 acres making a total of 86,800 acres. The Public Works Department at present, however, only provide for water for 75,000 acres, which I shall distribute as follows :—

	ACS.
Tanjore	30,000
Mannārgudi	15,000
Pattukkōttai and Alangudi	30,000

44. The second crop area in Tanjore 30,000 acres will be mostly in villages 10, 12 to 15, 25, 33 to 38, 58 to 65, 78, 141 to 145 and 162 to 176. About 24,000 of it will be Government occupied dry, 4,000 Government occupied wet, and 2,000 acres inam. This second crop inam area will certainly be realised. These figures will be found in returns E and F.

45. In Mannārgudi, the total new second crop area is 15,000 acres. This area will be mostly at the north half of the taluk chiefly in villages 1 to 12, 15 and 26. Of this second crop area roughly 1,000 acres may be whole inam, the balance Government, 2,000 acres wet and 12,000 dry. It will be better to give the second crop water as far as possible to Government occupied dry land as it is better soil and pays more than the present occupied wet. These figures will be found in returns E and F.

46. In Pattukkōttai and Alangudi the new second crop area 30,000 acres will be mostly in villages 1 to 7, 26 to 30, 196, 228, 229, 233 to 238 and 243 to 252 of Pattukkōttai and in Alangudi practically throughout as this latter area lies close under the main channel. I estimate that 7,000 acres in Alangudi will take a second crop and the remaining 23,000 acres will be found in the above Pattukkōttai villages. It will be roughly 12,000 acres zamin and 11,000 acres Government, practically all dry land. I anticipate no difficulty with the second crop zamin provided the survey of zamin lands recommended above is made. The figures will be found entered in returns E, E-1 and F.

47. Return F gives the general summing up of the irrigable area. It shows that water will have to be provided altogether for a first crop area of 333,274 acres and a second crop area of 145,000 acres, in all 478,274 acres. No area is entitled to water free or at favourable rates.

48. *Revenue accruing from new irrigation.*—Having found the irrigable area available, I next consider the revenue which will probably accrue from it. The main canal and its distributaries and the Vadavar improvements will be designed so that all the land under them will have practically the same facilities and advantages as regards supply of water as, and will be on a similar footing to, the present first class delta lands and the new area should be classed under "wet class I". I may assume then that all the Government irrigable area will eventually be converted into first class wet at delta rates. The conversion or at least the raising of rates cannot, of course, take place during the pendency of the current settlement, which continues to 1923. But as the construction of the reservoir, if sanctioned, will hardly be begun before 1912–13 and will take about 10 years to build, the present settlement will only have one year to run when the scheme is complete. It is fair then to estimate the revenue that the scheme will eventually bring in on the assumption that the re-settlement has taken place and I proceed to estimate it on that assumption.

49. In my report of 1905, I drew up "conversion tables" giving the average rates per acre for the Government areas in the three taluks now concerned (and others), giving the differences between the existing rates for occupied lands, wet and dry, and the rates chargeable after converting these into I class delta wet. I have adopted those rates in this report also and have embodied them in a convenient table in return H, adding also the proper second crop charges for crops on registered single crop lands. The revenue derivable from the Government irrigable areas in the three

taluks will then be as calculated separately in each E return and consolidated in return F. A certain extent of the dry land in all the taluks is "manavari" or "rain-fed", assessed at a taram higher than the corresponding "dry" soil, but the extents are comparatively small and will not appreciably affect the figures. The portion of the "total revenue" figures which is "indirect revenue" is that figure which represents the land revenue (exclusive of water charges) on waste lands now brought under cultivation and a percentage of the same realized by the sale of these waste lands. Return H shows that the average of that land revenue for Tanjore and Mannārgudi taluks is, taking II group land, which comprises the greater portion of the unoccupied land, rupee 1 and for Pattukkōttai taluk, 14 annas. These rates multiplied by the available unoccupied waste, wet and dry, will give the one item. The other I have calculated at 4 per cent on the estimated sale-proceeds of the available unoccupied waste land. My estimate of the sale price of these in 1905 was, I think, much too low, and I have raised the sale figures to Rs. 8,070 and 60 per acre in Tanjore, Mannārgudi and Pattukkōttai taluks, respectively.

50. For all the non-Government areas, I adopt again the water-rate fixed in my report of 1905 for my I class "zone," namely, Rs. 5 an acre for first crop and Rs. 3 an acre for second crop. My reasons for fixing this rate are given at length in paragraphs 46 and 47 of my former report. Now there is no reason for having a "second class zone" and I class zone rates will be applied throughout to all non-Government lands, including the areas in Pudukkōttai State. The resultant revenue figures are given in the E and E returns and consolidated in return F.

51. *Propriety of charge on existing delta.*—In addition to this revenue directly due to the new area and increased second crop cultivation in the delta, the question has been raised whether, in view of the undoubted fact that the reservoir will steady and render continuous and certain, instead of fitful and fluctuating, the water-supply to the present delta, a small increase of assessment, to represent the money value of that increased steadiness of supply, should not be imposed on the existing delta. My opinion on this point is that no good case can be made out for imposing an extra assessment on this account on the present I class delta lands. Their supply is now very assured and they very rarely suffer from short supply. Further, the attempt to increase the assessment on lands which are supposed to be enjoying the best irrigation supply seems to lack logic and will be attended with practical difficulties. It is agreed that no distinction can be made between the old delta and the new area as regards claims on the water of the reservoir. My new area rates are based on the water-charge necessary to bring the new area up to existing I class delta. If I class delta charges are to be increased, any increase put on them ought in fairness to be imposed over the whole new area also, otherwise the latter area will be obtaining for a less price the same irrigation facilities as the former. I am not of opinion that such an extra charge on the new area could not be justified. It might, I think, with much show of reason, be claimed as Government share of the large unearned increment in the value of his land to the ryot, which the supply of water to his land always puts in his pocket. Or again it could be claimed that the new area cannot expect water at old delta rates, as the old delta was provided by nature with irrigation channels whereas in the case of the new area, every distributary has to be cut and paid for. On the other hand without increasing the charges on the present delta it is open to Government to say that if the scheme will not pay with the existing rates over the new area, then the new area must pay increased rates, and as I said above, there is justification for this. It would mean, of course, that part of a system would be paying higher rates than another part, each having equal claims on the water, and the danger would be the temptation in times of scarcity to benefit the higher paying lands at the expense of the lower. That, however, I think, is a small matter. I think myself that, if the scheme will not pay with a 5 rupees and 3 rupees rate over the new area, the rate ought to be raised, say to Rs. 6 and 4 or Rs. 7 and 4. It would have to be raised considerably above that before it will exceed the real market value of the water to such a tract of arid ground and scanty crops.

52. To return, however, to the question of extra charge on the delta, I consider that an extra charge on the I class delta *on the ground of benefit from the reservoir*

would not be justified. I do not think this land will derive any substantial benefit from the reservoir, while any small benefit it may derive may well be set against occasional risk of late supply and deprivation of silt.

53. The above remarks, however, do not apply to the case of II and III class delta land. This land is, by hypothesis, at present not so favourably situated as the I class land, and it may reasonably be expected that much of it will, with the new reservoir, be put on a par with the I class land. There is II class land in every delta taluk and undoubtedly the II class land in them all will be in future as favourably situated in irrigation facilities as the new land in Pattukkottai taluk which will be I class land. There is also III class land in every delta taluk, and I regard it as probable that all the III class land will be in future in as good a position as present II class. I consider therefore that the reservoir may fairly take credit for raising all the II class delta to I class and all the III class delta to II class, and assume as before that the re-settlement sanctioning these changes has taken place.

54. A glance at return J extracted from the settlement report of Tanjore, will show approximately the Government areas of I, II and III class delta in Tanjore at time of settlement. The average assessment on I class is Rs. 7-15-10 per acre, on II class Rs. 6-2-10 and on III class Rs. 4-9-8. The average II class land is then, as the table of settlement rates (statement G in 1905 report) will show, practically 7th taram wet, whose rate II class is Rs. 5. The land in this taram when raised to I class appears in the 6th taram, charged Rs. 7 per acre. The average rate of conversion from II class to I class is therefore Re. 1. Similar calculations will show the average rate of conversion from II class to II class as 8 annas.

55. The total Government delta area in Tanjore as per settlement is 714,000 acres. Now the total average firstcrop under the Cauvery system is about 890,000 acres (see return K). The difference of 176,000 acres is inam water-rate land, extensions since settlement and some irrigation in Trichinopoly and South Arcot districts. It is not easy, and for the purposes of this report not necessary, to get accurate classification of these various items. I shall assume fairly enough, I think, that this 176,000 is divided in the same proportions as the 714,000 acres. Return J will show that of the latter roughly 32 per cent is I class, 51 per cent II class and 17 per cent III class delta. I assume therefore that the 890,000 acres first crop Cauvery delta system is divided as follows:—

32 per cent	... ...	284,800 acres	... I
51 „	... ...	453,900 „	... II
17 „	... ...	151,300 „	... III
	Total ...	890,000 „	

Conversion of this II class area to and III to II will then give us an additional income from delta I crop of

453900 × Re. 1 =	Rs. 4,53,900
151300 × As. 8 =	Rs. 75,650
	Rs. 5,29,550

56. The average II crop area in the delta is (by return K) 96,000 acres; to this has to be added the extra 70,000 acres mentioned in paragraph 40; total 166,000 acres. This will be probably wholly in I and II classes and I do not think it will be far wrong to assume that 100,000 acres of it will be on existing I class land. We then have 66,000 acres II class which when raised to I class will give an additional second crop revenue of 66,000 × As. 8 or Rs. 33,000. The total extra charge on the delta will come therefore to Rs. 5,62,550 or say 5,60,000 rupees. I enter this figure in general return F. I may remark in passing that if III class was also raised to I class, the figure would be Rs. 7,13,850 or about 7 lakhs.

57. *Credit for remissions.*—In statement L, I have collected statistics, so far as they are available, of the amount of land revenue remitted in the district of Tanjore within the last ten years on account of unfavourable season. It is divided into two heads, remission on account of short crop and shavi and remission on account of inundation or floods. The latter is wholly confined to the delta parts. Of the former

the whole of the Pattukkōttai taluk figures and about half of the Tanjore and Mannārgudi figures belong to non-delta irrigation. We may say roughly that in the delta in the last ten years, for both first and second crops, Rs. 1,73,000 have been remitted on account of shavi and Rs. 1,48,000 on account of floods, on an average per annum of Rs. 17,300 for shavi and Rs. 14,800 for floods. Now when the new reservoir is constructed, it seems to me certain that there will be no danger of loss of crop from floods, as the reservoir will hold up all surplus water, and it is probable, I reckon, that the danger of shavi will be reduced by at least two-thirds. Thus annually a saving of about Rs. 25,000 remission will be accomplished and it appears to me that the reservoir is entitled to put this sum annually to its credits. I have therefore entered it in general return F.

58. The total annual gross revenue from the project then appears from column 17 of F to be Rs. 27,33,626. From this gross sum have to be deducted the "revenue collection" and "working expenses" charges.

59. *Maintenance charges.*—These, I am instructed by the Special Superintending Engineer's letter No. 246-M/211, dated 9th May 1910, to calculate at 11 per cent of all revenue except proceeds of sale of waste land for "revenue collection and management" and As. 13-6 per acre on total first crop for "maintenance charges". I have accordingly made these deductions in return F. It leaves a net revenue of Rs. 21,59,359 or 21½ lakhs.

60. *Cost of scheme—Compensation.*—The amount of land compensation which will have to be paid for acquisition divides itself into two parts: (1) that for the acquisition of the private land and property submerged by the reservoir, and that required for surplus escape and dam works; (2) that for the acquisition of the land required for the main Grand Anicut channel and distributaries.

61. The full tank level of the reservoir with which my 1905 report was concerned was about + 730 feet. The F.T.L. of the present one is about + 790 feet. The dam of the present one is about 7 miles higher up the valley than the previous one. Consequently the compensation amount previously fixed by me for the reservoir (enclosure A to the 1905 report) has on the one hand to be increased by the compensation for all private land and property between F.T.Ls. + 730 and 790, and + on the other to be decreased by the amount of compensation for land between the two dam sites previously included in the old reservoir. I have taken an enclosure A of the 1905 report as my basis, and retained its figure so far as they are concerned with land still to be submerged. I have thrown out compensation for the land now between the two dam sites and I have added with the aid of the settlement maps (marked with the F.T.L. lines) and diglotts, an approximate estimate of the extent of new private land submerged. The result will be found in return M, which I have written up, as far as Salem and Dharmapuri villages are concerned, under the re-settlement village names. The Kanveripuram area is less than in 1905, but I have followed the area marked as submerged by the Public Works Department Overseer.

62. The small areas required for surplus escape and dam works are separately estimated and shown in M.

63. In addition to the private patta land, the new reservoir will submerge on each side a strip of reserve forest. The extent has been roughly estimated from the forest contour maps, and measures on the Coimbatore side about 1,500 areas and on the Salem side about 25,000 acres.

64. On the Coimbatore side there is, according to the District Forest Officer, North Coimbatore, no valuable timber, and he values the scrub at about Rs. 5 per acre *in situ*. This would give a value for the Coimbatore forest of Rs. 7,500.

65. On the Salem side there is valuable timber in North Salem forest. The District Forest Officer, North Salem, values this timber and scrub at about Rs. 30 per acre *in situ* and the District Forest Officer, South Salem, values his at Rs. 7-8-0 per acre. Both the District Forest Officers consider it fair that the Public Works Department should pay only half the estimated rates in consideration of the facilities that the lake will give in future for the transport of forest timber. The

same plan may be adopted for the Coimbatore forest, which the District Forest Officer was willing to surrender for nothing. The resultant figures for compensation for forests are entered in return M.

66. The Public Works Department intend to cut down and use all the timber which will be submerged. They will require large quantities of fuel on the works, which the surrounding forest can supply, and as early as possible some indication should be given by them to the Forest departments of both the districts of the direction and system of coupes which would suit them best: cutting outside the F.T.L. will of course be done by the Forest departments themselves.

67. The total figure for reservoir land compensation is thus about $5\frac{1}{2}$ lakhs which is entered in the return of cost of works marked O.

68. Compensation for the area required for channels divides itself roughly into three parts: (*a*) for area required for main canal and distributaries (miles 1 to 30) from Grand Anicut to Tanjore town; (*b*) for area required for main canal through Tanjore town; (*c*) for area required for main canal and distributaries from Tanjore town to the end, miles 30 to 88.

69. The area required for (*a*) is, according to a rough statement (return N) given by the Special Executive Engineer, about 1,918 acres. The main channel for about 4 miles runs through existing "wet", tank and drainage fed, and of no great value say Rs. 200 an acre, and for the rest through fairly good dry land of average value, say Rs. 80 per acre. The distributaries will be in this latter land. The compensation for (*a*) will then be Rs. 160 × 200 + 1,758 × 80 = Rs. 1,72,640 *plus* 15 per cent for compulsory acquisition, total Rs. 1,98,536 or say 2 lakhs, on the assumption that all the land is occupied.

70. As to (*b*), it will be convenient first to state here why and how the main channel has been aligned to run through Tanjore town. The first alignment was to the south-west of the town and involved heavy cutting through the Vallam ridge. The Special Executive Engineer Mr. A. Campbell hit upon a line through Tanjore town, which was not only in itself excellent for the conveyance of the water, but to some extent was already made (as it runs through the Fort moat and two or three tanks), and effected a saving of some 2–3 lakhs in construction. The only difficulty was that the alignment ran through a Muhammadan burial ground and some opposition to this was anticipated. However, we were able to come to terms with the Muhammadan community and obtained their consent to the necessary land for the channel being acquired. I have handed over their mahazar consent to Colonel Ellis, Special Superintending Engineer.

71. The price of the various concessions to the Muhammadans detailed in No. 18-D., dated 22nd April 1910, will not come to more than Rs. 1,500 (exclusive of the bridge included in the general estimate). The amount of compensation to be paid for acquisitions in Tanjore town will come to about Rs. 16,540. As regards this land I urge that the acquisition of such of it as is open private land should be put in hand at once, otherwise speculators knowing the alignment of the channel, which is now pegged out, will run up the price.

72. As to (*c*) the area required according to the Executive Engineer's statement is 2,784 acres. This is practically wholly through light dry land of no great value. I should average it at Rs. 50 per acre, making Rs. 1,39,200 *plus* 15 per cent for compulsory acquisition, total Rs. 1,60,080 or say Rs. 1,60,000, on the assumption that it is all occupied land.

73. A sketch-map showing the main distributaries accompanies this report marked N_1.

74. The total amount to be paid in compensation for the channels and distributaries is Rs. 3,78,040 and is entered in return O.

75. *Abatement of land revenue.*—The amount of land revenue lost on the submerged area of the reservoir is given in column 4 of M. It is Rs. 8,900. This, capitalised at 25 years' value, gives Rs. 2,22,500 as the total loss of land revenue. I enter this figure in O.

76. As for the abatement of land revenue on the land required for channels and distributaries, assuming that it is all occupied patta land, there is the assessment on 1,918 acres up to Tanjore town, 160 acres wet and 1,758 acres dry. The assessment on the wet land won't exceed Rs. 10 an acre and that on the dry Rs. 1-8-0. The land revenue lost will therefore be Rs. 1,600 + Rs. 2,637 = Rs. 4,237. There is no loss of land revenue in Tanjore town. Beyond Tanjore town, there is the assessment on 2,784 acres. Of this about 1,200 acres is in Tanjore taluk and the balance in Pattukkōttai taluk. It will practically all be "dry" land, II class. Statement H shows that the average II class dry land assessment in Tanjore taluk is Re. 1 and in Pattukkōttai taluk is As. 14. The land revenue lost will therefore be Rs. 1,200 + Rs. 1,386 = Rs. 2,586. The total abatement of land revenue on the channels and distributaries will be Rs. 4,237 + Rs. 2,586 = Rs. 6,823, say Rs. 6,500, as all the land will not be occupied land. This, capitalized at 25 years' value, yields Rs. 1,62,500, which figure is entered in return O.

77. *Cost of works.*—As regards the items entered in return O under this heading, I invite attention to the letter to me of the Special Superintending Engineer, No. 546-M./211, dated 9th May 1910. He estimates the cost of reservoir works, including everything but land compensation and indirect charges at Rs. 227 lakhs. For cost of constructing channels he takes Mr. Stoney's estimate given on page 71 of G.O. No. 461 I., dated 10th December 1908, and adds 8 lakhs to it. The figure for land compensation should be thrown out of this estimate. We then get about 92,50,000 *plus* 8 lakhs, say 100 lakhs roughly. Establishment at 23 per cent of this comes to 23 lakhs and tools and plant at 1½ per cent to 1½ lakhs. The leave and pension allowances are calculated at 14 per cent of the total establishment charges (38, 0,000 + 23,00,000 = 61,70,000) as Rs. 8,63,800. These figures are entered in return O. The total cost of the scheme is thus Rs. 3,73,26,840. The net revenue 21½ lakhs is thus 5·76 per cent of the total cost. If instead of Rs. 5 and 3, rates of Rs. 6 and 4 or Rs. 7 and 4, none of which I regard as too high a price for the water given, are charged, the net revenue would approximately be 24·8 lakhs and 27·5 lakhs, respectively, and the interest on capital cost 6·65 and 7·37 per cent, respectively.

78. *The method of working the reservoir.*—The method of working the reservoir and the question whether it will interfere with or hamper the present delta irrigation are important matters. A set of tables giving the theoretical working of the reservoir has been drawn up by the Special Superintending Engineer on the assumption that the reservoir, along with the ordinary river supply in the Bhavani and Amaravati rivers and the ordinary rainfall in the delta will have to supply (1) the existing delta and lower anicut irrigation, and the additional 70,000 acres double crop in the delta, in all about 997,000 acres first crop and 160,000 acres second crop, (2) new irrigation under Grand Anicut canal and Vadavar extension amounting to 330,000 acres first crop and 75,000 acres second crop. The figures given in return F show that this latter area is available for irrigation. The total area to be supplied will then be, first crop 1,327,000 acres and second crop 235,000 acres. On this assumption working tables for the reservoir have been drawn out for 16 years from 1890-91 to 1907-08 and are in the Special Superintending Engineer's office. They show (*see* also G.O. No. 72 I., dated 11th March 1910) roughly that from 1890-91 to 1908-09 uniformly the reservoir would have supplied with success the whole first crop area, and that only in two years 1899-1900 and 1905-06 would there have been any serious shortage of water for the second crop. It is clear from these tables that the scheme promises very well, and is able to perform what it undertakes.

79. Now the assumption on which these tables are drawn out is that all Cauvery water in the year up to 31st May should be impounded, and that on whatever date after that the water in the reservoir is sufficient to justify issue, the water will be issued. No distinction is drawn between the old irrigation and the new. Both have the same claims on the water and will share according to their requirements. It is intended, as far as may be practicable, to issue water for double crop land on 1st June and for single crop land on 15th July. Water will be supplied in full supply to double crop land for 7½ months from date of first issue and to single crop land for

5 months from date of issue. During the 16 years under investigation, water would have been issued to double crop lands on 1st June in 11 years, once on 5th June, once on 23rd June, once on 25th June, once on 30th June, and once on 17th July, and to single crop lands on or about 13th July in 11 years, on 1st July in 3 years, on 5th July in 1 year and 25th July in 1 year.

80. We may assume then that in a normal and average year the reservoir will be able to issue water for double crop lands on 1st June and to single crop lands on 15th July. Will this impounding of water up to 1st June and delaying in issuing it to single crop lands until 15th July, seriously affect the present delta irrigation or the extension of irrigation over the new area?

81. I am quite satisfied that it will not. The general course of the Tanjore delta cultivation season is described in paragraphs 114 and 115 of my 1905 report. Enquiries made then and further enquiries made now prove without doubt that no appreciable area of land is brought under water now before 1st June. In Tanjore and Kumbakōnam taluks watering and sowing of first crop on double crop lands begin about 1st June. All other taluks are later, some, as Shiyali, being as late as 15th July. The general practice is to grow as a first crop a kuruvai or kar crop, which requires water for 3 to 3½ months, and it is essential that that should be harvested before the breaking of the north-east monsoon on 15th October. No hardship would be done to the delta and no material change in the present dates of irrigation would be caused if the reservoir was not opened till 15th June and there would be ample time to grow and harvest the kuruvai crop between then and 15th October. This is in fact the present "mamul" practice over the greater part of the double crop area in the delta. I am told, that just at the "breast" of the delta, there is an extent of 600—100 acres, which normally is sown at the beginning of May and transplanted at the time of the early freshes at the end of May. But the seedlings in this area are grown under wells, and admittedly not under "freshes" water, and further it is plain from a perusal of the dates when the Grand Anicut sluices are opened each year, that this area cannot have received any "fresh" before the 1st June. The area is under "Cauvery", and the tables (copy as return P) supplied by the Executive Engineer, Cauvery Division, along with his letter No. 2938, dated 29th April 1910, to the Special Superintending Engineer, show that the Cauvery sluices are practically never opened until the beginning of June. So, clearly, this early irrigation is not due to "early freshes", nor will the working of the reservoir interfere with it in any way. Even if in future, as the Executive Engineer hints, until the reservoir is built, early freshes are at once passed down the Cauvery and Vennar because the sand sluices of the Grand Anicut are done away with, that will confer no vested right on wet lands to have such freshes passed down at once, instead of being impounded till early in June.

82. I have heard it said that as at present the early freshes are wholly utilized in the existing delta, it is not apparent where the water is to come from to supply the new double crop irrigation. To this I reply that the working tables show sufficient water for all. I also point out that the delta Tahsildars are agreed that the ryots do not start cultivation until the "freshes" in the river are well-established. It is therefore evident that the "early freshes" are not wholly utilized and probably run to waste or are uselessly absorbed in the channel beds. Further, the reservoir will not interrupt early freshes, in the Bhavani and Amaravati rivers.

83. It is even more plain that the proposed working of the reservoir will not interfere with single crop land cultivation, by issuing water to it on 15th July. Most single crop cultivation does not begin now until the end of July or middle of August, and in Shiyali not till the beginning of September. Clearly then the reservoir will considerably improve the single crop prospects, by advancing its cultivation by 2-4 weeks and rendering it less liable to withering or floods late in the season.

84. It is quite evident then, that impounding the early freshes in the reservoir until the water has become sufficient to supply the delta needs with certainty will not only not seriously interfere with or harm the cultivation, but will materially benefit it, by giving to the ryot the knowledge that he can proceed with confidence to plough and sow, as the reservoir is holding sufficient for his needs

85. At the same time, it is probable that the working of the reservoir to supply both the delta and the new area may necessitate interference with existing "moras" and customs, and possible that vexatious application for injunctions and civil suits may be filed against Government by those in the delta or between the delta and the reservoir who imagine that their vested rights to "early freshes" or to supply of water are being interfered with; and that the work of constructing the reservoir may be thus considerably hampered. It is therefore essential that the proposed Irrigation Bill should be designed to meet at every point such claims and vexatious objections, and should become law before the commencement of the interference by Government with the natural flow of the Cauvery river.

86. *Rate at which irrigation is likely to extend.*—On this question my opinion is as follows:—I have shown, I think, that the construction and the working of the reservoir will not interfere appreciably with the present irrigation methods and system in the delta. The impounding of water up to 1st or 15th June will not affect the present irrigation and is not subtracting anything from its present supply. The present supply, according to the tables, can be fully maintained while the new irrigation is spreading. I do not see therefore why the new irrigation should not spread uniformly with the building and increasing capacity of the reservoir, nor do I think it right to assume that the first few years of its construction will be abnormally poor ones, and that therefore new irrigation cannot spread until the reservoir is two-third complete, which is the view of the Special Superintending Engineer. For the purposes of theoretical estimates, I think we must assume ordinary normal conditions, and allow that bad years are not isolated but will be compensated by good ones. I have put in return Q my estimate of the growth of irrigation and revenue. I think that second crop extension in the delta will begin first and yearly, about the third year and increase annually by about 15,000 acres. I expect the new irrigation to start in the fifth year and to increase by 50,000 acres per annum first crop and 12,000 acres per annum second crop. I have calculated the direct revenue on an average struck from the totals in return F at Rs. 3–12–0 per acre second crop delta extension, Rs. 4–13–0 per acre first crop new irrigation and Rs. 3 per acre second crop new irrigation. In the 12th year 1923–24 the increased charge on the delta becomes an asset and is entered.

87. I have not drawn up the usual Public Works Department estimate of net financial results as I have no figures of the progress of expenditure on the new estimate of works.

88. I notice in conclusion a few miscellaneous points.

89. *Bridges and communications*—The existing roads and paths and railway are in my opinion sufficient for the increased traffic likely to spring up. I have reserved all existing road path and railway porambokes. The affected area is well supplied with roads and paths. The "works" estimate (page 11 of G.O. No. 461 I., dated 10th December 1908) provides for forty road bridges and two railway bridges. The provision of bridges seems to me sufficient. I would urge that a ford at every five miles be provided across the main channel and its larger distributaries.

90. *Comparison with other irrigation works.*—I have not entered into a comparison of this scheme with other irrigation works and other revenues in other parts of the Presidency. I have based it on the present Tanjore delta, as the latter obviously is the most similar in conditions to the new scheme. My figures all through, as is patent, are founded on the results already obtained in the Tanjore delta.

91. I think, I have dealt with most of the points in Board's Standing Order No. 88 and Public Works Department Code, paragraph 737, which concern the Revenue Department. I deal briefly with the few remaining points.

92. The chief markets for agricultural produce are Negapatam and the other ports. Exports of agricultural produce are mainly of grain to Ceylon, of tobacco to the Straits Settlements and of groundnut to Marseilles. The existing trade routes of the district are the main roads and the railway (South Indian Railway and District Board Railway). The former runs through the tract affected from the Grand Anicut to Tanjore, the latter from Pattukkōttai to close to Arantangi.

93. The important corps of the district with approximate areas of cultivation as per fasli 1317 are given in return R.

94. I have consulted the Local Revenue Officers, generally on the scheme. They agree in thinking it eminently desirable. I did not take their views as to the financial results, as obviously they had no data to go upon until this report was prepared.

95. I have been instructed, in order to avoid delay by further reference to the District Officers, to send a copy of this report to the Collector of ~~Tanjore,~~ for his remarks, and I am doing so. At the same time, as the present Collector (Mr. R. F. Austin, I.C.S.) is quite new to the district and has been only about a month in charge, I consulted the previous Collector (Mr. J. P. Bedford, I.C S.) who knows the district thoroughly, at all stages of my enquiry, and obtained from him a brief note, of which I enclose a copy, marked *S* on the chief points on which I thought his opinion would be valuable.

96. The Special Superintending Engineer wished me, if possible, to provide for him colour-washed village maps of the area which I considered to be irrigable. It has been held in Board's Standing Order No. 88 that "it is not necessary that the Revenue Officer should attempt to ascertain exactly what lands in individual villages will or may be irrigated". It was not practicable to compile such maps. As is evident from my report, the natham extensions and dry belts in Government villages cannot at present be localised. The same remark applies in part to the land reserved for grazing. The Public Works Department main channel and distributaries have not yet been pegged out and it is impossible to say now what fields may have to be acquired for them. There are no maps for non-Government areas, and it would be little use providing washed maps showing the Government irrigable area (only 36 per cent of the whole) when for all the balance of 64 per cent, no maps at all can be furnished. The rough registers prepared by the Tahsildar will give the fields in each Government village, which I consider likely to be irrigated. It is impossible to give similar details for non-Government villages.

97. Grant of commanded land on darkhast should now be prohibited, of such prohibition has not already been made.

98. I am depositing all the records of my office, not forwarded with this report, in the office of the Collector of Tanjore. The maps I have used will be returned to the respective Collectors.

99. I have to acknowledge the assistance I have received from my special Tahsildar Mr. K. Rangachari, Sub-Magistrate, Tanjore district, who has worked ably and energetically under me.

Number.	Number of village.	Total area.	Whole inam area.	Minor inam area.	Net Government area—column 3—columns (4+5).	Area commanded. Wet. Occupied.	Wet. Unoccupied.	Dry. Occupied.	Dry. Unoccupied.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.
10	Kadambangudi ..	709·43	..	1·18	708·25	78·12	..	14·32	19·70
12	Sholagampatti	2,158·77	..	..	2.158·77	339·07	31·65	..	74·54
13	Surakkudipatti	1,467·01	..	..	1,467 01	28·78	2·99	8 63	44·11
14	Kangiyampatti	2,986·13	..	..	2,986·13	411 23	28·50	160·37	523·21
15	Marueri	1,050·81	..	0·66	1,050·15	425·91	1·44	91·97	85·05
33	Nandavanapatti ..	1,946·96	..	..	1,946·96	192·81	2·92	144 84	50·99
34	Avarampatti	834·45	..	..	834·45	162·17	4·58	17·50	..
35	Budalur	2,068·31	..	0·93	2,067·38	50·41	..	72·38	10·85
36	Kovilpatti	1,051·20	..	2·59	1,048 61	53·34	..	92·40	55·93
37	Chittiragudi	2,042·93	..	4·09	2,038·84	126·95	0·43	252·36	135·91
38	Royandur	1,455·41	..	..	1,455·41	739·72	2·71	13·47	0·60
58	Parambur 1st Setti ..	816·53	..	24·75	791·78	..	..	17·91	0·17
59	Perambur 2nd do. ..	2,067·54	..	1·02	2,066·52	..	0·71	257·33	252·74
60	Kalivarayampatti ..	1,373·50	..	..	1,373·50	..	..	306·23	28·64
61	Alakkudi	2,265·12	..	..	2,265·12	..	..	777·66	89·48
62	Vannarapatti	1,990·39	..	0·25	1,990·14	34·66	3·94	479·72	169·49
63	Sakkaraisamandam ..	707·71	..	..	707·71	..	3·51	100·22	55·50
64	Siralur	739·60	..	..	739·60	..	26·99	189·69	108·74
65	Pillaiyar Natham ..	1,694·54	..	..	1,694·54	..	0·92	721·02	67·16
123	Alangudi	1,127·84	13·02	97·42	1,017·40	6·49	0·25	263·99	1·61
124	Pulavanatham	806·26	..	10·01	796·25	7·05	..	170·48	1·03
125	Kumilakkudi	1,054·10	..	..	1,054·10	..	..	38·12	2·13
126	Pundi	1,752·88	..	0·64	1,752·24	..	..	508·30	21·82
129	Saliyamangalam ..	1,385·10	..	31·15	1,353·95	..	0·20	251·44	1·29
130	Palliyur	1,268 82	.	0·85	1,267·97	132·30	..	25·75	3·51
132	Kilakovilpattu	1,500·88	..	147·11	1,353·77	..	0·12	334·55	38·40
133	Vadapattu	1,962·53	..	..	1,962·53	..	4·32	294·37	3·49
134	Puttur	1,331·32	..	118·81	1,212·51	..	0·58	696·43	10·01
135	Neduvasal	1,168·44	16·27	71·91	1,080·26	..	..	310·82	9·77
137	Puliakudi	2,902·66	..	32·58	2,870·08	..	1·21	1,569·09	191·87
138	Arindavapuram	2,291·35	..	37·01	2,254·34	..	..	1,450 71	179·19
139	Kambayanatham	2,465·41	743·50	0·51	1,721·40	329·42	0·86	481·30	27·66
140	Tiruppuvanam	3,515·41	2,446·14	9·64	1,059·63	..	..	931·74	25·05
141	Nallavanniankudikkadu.	1,705·79	..	4·32	1,701 47	..	..	1,371 24	5·65
142	Ragbavambalpuram ..	3,652·30	..	29·86	3,622·44	67·26	5 50	2,497·58	198·32
143	Murthiambalpuram ..	1,849·27	..	12·52	1,836·75	128·20	1·13	1,192·05	195·53
144	Neivasal Tenpathi ..	2,752·37	..	7·18	2,745·19	297·04	1·68	1,705·46	127·30
145	Ponnappur Kilpathi ..	2,448·55	..	3·10	2,445·45	225·93	0·68	1,282·73	253·17
146	Kulamangalam ..	3,052·78	1,013·71	24·83	2,014·24	377·92	3·45	656·54	133·69
147	Okkanadu Melaiyar ..	2,967·67	7·52	13·82	2,946·33	419·53	268·16	1,185·44	212·31
148	Okkanadu Kilaiyar ..	2,547·72	12·45	2·23	2,533·04	227·11	5·07	1,357·30	50·66
149	Kavarappattu	665·50	..	4·05	661·45	..	..	526·71	96·95
150	Arumulai	1,174·95	..	8·00	1,166·96	187·45	5·01	325·20	407·41
151	Tirumangalakottai Kilaiyur.	2,654·72	..	7·72	2,647·00	86·45	0·98	1,197·54	468·41
152	Tirumangalakottai Melaiyur.	2,977·51	..	14·67	2,962·84	242·77	58·63	996·58	1,162·81
153	Puvathur	2,685·37	..	..	2,685·37	333·50	17·64	1,180·97	207·61
154	Peikkarambankottai ..	1,149·41	..	0·64	1,148·77	88·84	123·07	732·13	18·63
155	Pulavangadu	980·87	..	..	980·87	62·42	20·38	645·74	106·86

areas—Tanjore taluk.

Poramboke.	Total of columns 7 to 11.	Area uncommanded.						Remarks.
		Wet.		Dry.		Poramboke.	Total of columns 13 to 17.	
		Occupied.	Unoccupied.	Occupied.	Unoccupied.			
(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	
64·63	176·77	139·80	0·37	137·42	107·98	145·91	531·48	
23·88	469·14	231 26	29·84	31·96	6·86	1,389·71	1,689·63	560 acres forest.
11·12	95·63	388·65	1·22	68·48	45·62	867·41	1,371·38	100 acres grazing ground poramboke.
406·64	1,529·95	537·61	14·79	216·79	103·85	583·14	1,456·18	
442·78	1,047·15	..	..	..	..	3 00	3·00	Reserve, 75 acres unoccupied dry for grazing.
109·95	501·51	364·55	18·38	143·20	163·61	755·71	1,445·45	
83·65	267·90	78·23	0·51	251·73	2·38	233·70	566·55	
13·63	147·27	874·72	0·43	646·99	11·74	386·23	1,920·11	
81·91	283·58	253·75	4·61	295·66	64·61	146·40	765·03	
112·80	628 45	546·49	..	527·09	51·20	285·61	1,410·39	
293·13	1,049·63	67·84	3·29	92·60	26·55	215·50	405·78	Reserve, 0·60 acre unoccupied dry for grazing.
60·83	78·91	712·87	..	..	..	..	712·87	Reserve, 0·17 acre unoccupied dry for grazing.
731·84	1,242·62	823·90	..	..	..	..	823·90	Reserve, 100 acres unoccupied dry for grazing.
46·02	380 89	15·38	..	883·71	37·96	55·56	992·61	
128·02	995·16	..	..	1,035·53	149 18	85·25	1,269·96	
257·52	945·33	..	..	951·11	22·75	70·95	1,044·81	
110·39	269·62	438·09	..	...	..	..	438·09	Reserve, 55·50 acres unoccupied dry for grazing.
82·44	407·86	331·74	..	..	..	..	331·74	Reserve, 75 acres unoccupied dry for grazing.
169·97	959·07	735·47	..	..	..	..	735·47	Reserve, 67·16 acres unoccupied dry for grazing.
21·66	294·00	461·48	2·43	37·49	12·45	209·55	723·40	Reserve, 1·61 acres unoccupied dry for grazing.
35·91	214·47	469·39	0 05	28·99	2·03	81·32	581·78	Reserve, 1·03 acres unoccupied dry for grazing.
4·50	44 75	804·58	0·68	30·37	0·24	173·48	-1,009·35	Reserve, 2·13 acres unoccupied dry for grazing.
25·70	555 82	771·46	0·24	137·19	9·37	278·16	1,196·42	Reserve, 21·82 acres unoccupied dry for grazing.
235·44	488·37	865·58	..	..	..	..	865·58	Reserve, 1·29 acres unoccupied dry for grazing.
45·17	206·73	749·26	1·72	112 83	6·69	190·74	1,061·24	Reserve, 3·51 acres unoccupied dry for grazing.
332·03	705·10	648·67	..	..	..	..	648·67	Reserve, 38·40 acres unoccupied dry for grazing.
463·47	765·65	1,196·88	..	..	..	..	1,196·88	Reserve, 3·49 acres unoccupied dry for grazing.
139·26	846·28	366·23	..	..	..	..	366·23	Reserve, 10·01 acres unoccupied dry for grazing.
329·92	650·51	429·75	..	..	..	..	429·75	Reserve, 9·77 acres unoccupied dry for grazing.
443·96	2,206·13	663·95	..	..	..	..	663·95	Reserve, 100 acres unoccupied dry for grazing.
339·04	1,968·94	285·40	..	..	..	..	285·40	Reserve, 100 acres unoccupied dry for grazing.
120·67	959 91	6·44	0·05	504·86	68·53	181·61	761·49	
96·54	1,053·33	6·30	..	..	..	..	6·30	Reserve, 25·05 acres unoccupied dry for grazing.
315·71	1,692·60	..	..	0·91	4·73	3·23	8·87	Reserve, 5·65 acres unoccupied dry for grazing.
333·57	3,102·23	..	..	267·44	29·48	223·29	520·21	
319·84	1,836·75	..	..	..	..	..	..	78 acres forest.
613·71	2,745·19	..	..	..	..	..	..	14 acres forest; reserve, 86 acres unoccupied dry for grazing.
647·49	2,410·00	..	..	19·92	11·03	4·50	35·45	157 acres forest.
710·41	1,882·01	..	..	125·29	0·39	6·55	132·23	
860·89	2,646·33	..	..	..	..	..	..	300 acres forest.
892·90	2,533·04	..	..	..	..	..	..	Reserve, 50·66 acres unoccupied dry for grazing.
87·79	661·45	..	..	..	..	..	..	Reserve, 75 acres unoccupied dry for grazing.
241·89	1,166·96	..	..	..	..	..	..	78 acres forest.
893·62	2,647·00	..	..	..	..	..	..	611 acres forest.
502·05	2,962·84	..	..	..	..	..	..	Reserve, 100 acres unoccupied dry for grazing.
945·65	2,685·37	..	..	..	..	..	..	217 acres forest.
186·10	1,148·77	..	..	..	..	..	..	Reserve, 18 63 acres unoccupied dry for grazing.
145·47	980·87	..	..	..	..	..	..	Reserve, 75 acres unoccupied dry for grazing.

Number.	Name of village.	Total area.	Whole inam area.	Minor inam area.	Net Government area—column 3—columns (4 + 5).	Area commanded. Wet. Occupied.	Area commanded. Wet. Unoccupied.	Area commanded. Dry. Occupied.	Area commanded. Dry. Unoccupied.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.
156	Telungankudikadu ..	1,613·82	2·20	4·19	1,607·43	221·91	52·82	846·05	7·35
157	Kovilur	1,566·80	..	56·46	1,510·34	28·56	..	810·12	334·45
158	Palamputhur	1,418·16	..	3·63	1,414·53	209·74	71·71	755·22	31·20
159	Kakkarai	1,549·40	..	1·40	1,548·00	144·43	132·44	654·09	369·88
160	Kannandangudi Kilaiyur.	2,574·00	..	14·06	2,559·94	296·26	13·44	1,262 06	108·22
161	Ponnapur melpathi .	1,332·90	3·17	1·75	1,327·98	319·10	1·41	712·89 + 60	} 150·99
162	Paruthikottai	1,802·10	10·85	..	1,791·25	329·42	73·11	792·44	22·77
163	Ulur	1,679·16	..	..	1,679·16	289·61	4·17	916·24	7·43
164	Kila Ulur	1,486·46	343·78	15·05	1,127·63	165·70	0·56	665·76	103·61
165	Vandiyanirupu	1,181·91	..	..	1,181·91	187·43	3·00	808·48	33·36
166	Karamundakottai ..	538·23	..	..	538·23	150·17	..	258·09	9·32
167	Jambugapuram	994·68	..	..	994·68	81·95	7·52	785·01	0·58
168	Raramadrikottai ..	2,871·06	1,167·01	21·92	1,682·13	..	..	1,238·23	124·67
169	Valamirankottai ..	817·60	..	11·61	805·99	168·98	9·17	467·60	19·87
170	Kattur	1,068·31	..	..	1,068·31	371·90	2·65	496·08	26·75
171	Madigai	1.133·17	..	..	1,133·17	171·50	0·27	762·74	34·51
172	Puduvur	2,430·81	..	63·94	2,366·87	292·41	5·70	616·19	37·70
173	Kattu Kurchi	1,626·21	..	39·56	1,586·65	279·16	0·93	710·81	91·67
174	Aliyavaikkal	2,345·58	70·22	0·64	2,274·72	430·62	11·46	1,092·24	353·73
175	Panchanadikottai ..	678·98	..	..	678·98	111·52	..	445·01	53·26
176	Karukkakottai	1,047·60	..	..	1,047·60	81·30	10·11	549·93	30·42
177	Ichchankottai 1st bit ..	2,402·23	536·79	29·57	1,835·87	20·87	..	351·62	43·50
178	Naduvur	2,794·85	..	12·98	2,781·87	42·61	0·26	9·63	..
183	Vallam Vadakkusethi ..	2,042·56	..	95·14	1,947·42	..	..	243·07	12·77
190	Vellam Pudursethi ..	3,745·01	..	50·14	3,694·87	..	..	34·55	2·10
192	Kuruvadipatti	1,124·62	..	3·09	1,121·53	0·36	..	106·99	..
195	Viramarasampettai ..	1,505·01	..	1·42	1,503·59	19·14	8·94	65 07	81·95
211	Vendayampatti	2,424·75	..	2·81	2,421·94	12·48	..	..	..
	Grand Total ..	135,020·10	6,386·63	1,155·41	127,478·06	10,289·96	1,039·98	44,355·13	8,026·11

Total of wet classified—

		ACS.	ACS.
I Delta	.. ..	* 954·22	56·64
II „	.. ..	1,406·46	61·57
III „	.. ..	1,619·62	89·61
IV „	.. ..	4,640·97	716·42
V „	.. ..	1,644·25	115·74
	Total ..	10,265·52	1,039·98

* This excludes 24·44 acres of registered double crop wet in 14 Kangiyampatti.

areas—Tanjore taluk—*cont.*

		Area uncommanded.						
		Wet.		Dry.				
Porambоke.	Total of columns 7 to 11.	Occupied.	Unoccupied.	Occupied.	Unoccupied.	Porambоke.	Total of columns 13 to 17.	Remarks.
(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	
479·30	1,607·48	..	..	..	..	..	..	85 acres forest.
149·96	1,323·09	..	..	133·00	47·17	7·08	187·25	
346·66	1,414·53	..	..	..	..	..	..	Reserve, 31·70 acres unoccupied dry for grazing.
247·16	1,548·00	..	..	..	..	..	..	Reserve, 75 acres unoccupied dry for grazing.
879·98	2,559·94	..	..	..	..	..	..	193 acres forest.
142·99	1,327·98	..	..	..	..	..	..	Reserve, 75 acres unoccupied dry for grazing.
445·54	1,663·28	..	..	104·19	..	23·78	127·97	206 acres forest.
438·95	1 656 40	..	..	21·50	..	1·26	22·76	Reserve, 7·43 acres unoccupied dry for grazing.
92·01	1,027·64	..	..	97·60	..	2·39	93·99	Reserve, 75 acres unoccupied dry for grazing.
149·64	1,181·91	..	..	..	..	..	..	28 acres forest ; reserve, 33·36 acres unoccupied dry for grazing.
120·65	538 23	..	..	..	..	..	..	Reserve, 9·32 acres unoccupied dry for grazing.
119·62	994·68	..	..	..	..	..	..	Reserve, 0·58 acre unoccupied dry for grazing.
127·31	1,490·21	..	..	159·80	14·03	18·09	191·92	Reserve, 75 acres unoccupied dry for grazing.
140·37	805·99	..	..	..	..	..	..	Reserve, 19·87 acres unoccupied dry for grazing.
170·93	1,068·31	..	..	..	..	..	..	Reserve, 26·7[illegible] acres unoccupied dry for grazing.
164·05	1,133 17	..	..	..	..	..	..	Reserve, 34·51 acres unoccupied dry for grazing.
207·32	1,159·32	97·32	1·51	544·30	25·98	538·44	1,207·55	
207·95	1,290 52	5·60	..	244 96	12·82	32·75	296·13	
264·64	2,152·69	..	..	112·32	7·97	2·64	122·03	Reserve, 100 acres unoccupied dry for grazing.
69·19	678·98	..	..	..	..	..	..	Reserve, 53·26 acres unoccupied dry for grazing.
148·87	820·63	1·92	..	188·24	18·78	18·03	226·97	
21·79	437·78	1·25	..	687·22	57·68	651·94	1,398·09	
0·40	52·90	99·49	0·46	1,048·41	67·97	1,512·64	2,728·97	
104·06	359·90	..	..	1,185·92	17·89	383·71	1,587·52	
4·72	41·37	270·76	15·36	2,391·53	366·31	709·54	3,653·50	
25·48	132·83	33·26	5·19	784·70	48·01	117·54	988·70	
37·76	211·96	356·65	21·80	551·19	10·31	351·68	1,291·63	
..	12·48	495·68	63·90	799·42	184·57	865 89	2,409·46	
18,818·81	82,529·99	15,627·65	186·83	15,601·86	1,717·82	11,813·91	44,948·07	

Total reserve for grazing ground.

	ACS.
Unoccupied dry group I	567·49
Do. II	1,152·27
	1,719·76
Occupied dry commanded is—	
In group I	8,181·36
,, II	36,173·77
	44,355·13
Unoccupied dry commanded is—	
In group I	2,057·74
,, II	5,968·37
	8,026·11

STATEMENT A.—Government areas—

Number. (1)	Name of village. (2)	Total area of the village. (3)	Whole inam area. (4)	Minor inam area. (5)	Net Government area—column 3—columns (4 + 5). (6)	Wet. Occupied. (7)	Wet. Unoccupied. (8)
		ACS.	ACS.	ACS.	ACS.	ACS	ACS.
1	Muvarkottai	1,822·83	..	..	1,822·83	658·77	..
2	Vaduvur Vadapathi	2,995·38	..	28·13	2,967·25	427·20	1·02
3	Edangankottai Melaiyur ..	2,804·02	..	7·72	2,796·30	482 46	1·30
4	Vaduvur Agraharam	1,478·16	..	0·60	1,477·56	662 96	1·30
5	Vaduvur Thenpathi	3,908·93	1,007·40	4·01	2,837·52	643·44	9·63
6	Peraiyur	4,289·05	..	69·95	4,219·10	246·23	27·99
7	Sirumangalam	3,360·99	473·40	62·14	2,825·45	258 12	6·82
8	Mannargudi	1,340·25	23·20	318·24	998·81	..	..
9	Muvanallur Inam	5,586·60	5,586·60	..	..	..	..
10	Edangankottai Kilayur ..	2,566·95	..	6·51	2,560·44	831·39	145·84
11	Kalanjimedu	1,371·74		50·23	1,321·51	736 82	0·50
12	Royapuram	2,370·44	Estate Inam. 187·7 Shrotriem. 201·65	55·11	1,925·89	1,147·66	2·28
15	Kalachsri	1,575·27	Mukasa. 77·80	30·74	1,466·73	869·36 30 80	..
16	Munnavalkottai	3,389·91	Mukasa. 154·82 Whole Inam. 834·60	75·20	2,325·79	510·34	5·43
17	Adanur	1,432·82	Mukasa. 1·19	71·90	1,359·73	189·50 73·57	..
18	Kovilvenni	2,041·21	..	80·81	1,900·40	601·13	..
19	Sithamalli Melpathi	1,137 60	167·57	17·37	952·66	592·82	1·51
126	Peruvanludan	5,591·21	..	461·36	5,130·05	..	..
127	Palaiyur	2,324·98	828·34	134·58	1,362 06	807 02 241·10	0·74
128	Thenparai	1,907·08	..	2·37	1,904·71	790·51	2·99
129	Vallur	2,311·94	951·38	41·86	1,318·70	217·98 116 94	..
130	Maharajapuram	604·40	..	23·59	580·81	239·15	..
131	Tirumakottai	3,285·63	588·14	198·33	2,504·16	854·83	0·22
132	Melanantham	749·30		6·77	742·53	..	..
133	Kanduthampathi	3,907·13	3,207·16	0·80	699 17	131·35	1·36
134	Painganadu	5,004·83	3,304·95	13·12	1,686·76	125·75	..
135	Asesham	2,212·50	..	105·06	2,107·44	19·43	..
136	Gopiralayam	728 32	..	3·78	724·54	..	..
137	Neduvakottai	1,977 41	..	73·17	1,904·54	160·90	..
138	Pallakudy	1,764·50	..	28·22	1,736·28	75·76	20·62
139	Ullikottai	4,126·36	146·42	185·14	3,794·80	109·34	1·34
140	Mahadevapatnam	2,090·75	614·82 Mukasa. 4·98 Ch. 1·80	294·88	1,138·27	..	..
141	Nemmeli	932·52	..	2·68	929·84	..	..
142	Karuvakurichi	2,762·39	..	34·73	2,727·66	..	..
	Total ..	85,753·90	18,454·51	2,489 10	64,810·29	12,851·73	230·89

	Occupied.	Unoccupied.
	ACS.	ACS.
Total of wet class I and II delta	8,648 64	16·46
Do. III do.	2,269·97	149·70
Do. III, non-delta	689·33	27·28
Do. IV do.	964·83	29·77
Do. V do.	278·96	7·68
Total ..	12,851 73	230·89
Total of dry group, I	6,037·22	208·91
Do. II	24,485·24	5,467·30
Total ..	30,522·46	5,676·21
Total Manavari, special rate, dry	973·06	

Mannargudi taluk.

Area commanded.				Remarks.
Dry.		Poramboke.	Total of columns 7 to 11.	
Occupied.	Unoccupied.			
(9)	(10)	(11)	(12)	(13)
ACS.	ACS.	ACS.	ACS.	
797·27	19·22	347·07	1,822·83	Reserve, 19·22 acres unoccupied dry for grazing.
1,804·43	351·99	382·61	2,967·25	Do. 100 acres do.
1,412·55	196 53	703·46	2,796·30	Forest for grazing 261 acres.
340·61	4·19	468·50	1,477·56	Reserve, 4·19 acres unoccupied dry for grazing.
1,392·87	347·46	444·12	2,837·52	Reserve, 70 acres unoccupied dry for grazing; forest 30 acres.
2,124·57	632·37	1,187·94	4,219·10	Forest, 693 acres.
1,626·05	451·90	482·56	2,825·45	Reserve, 100 acres unoccupied dry for grazing.
616·39	2·62	379·80	998·81	Do. 2 62 acres do.
..	..	..	..	....
1,006·40	63·43	513·38	2,560·44	178 acres, forest.
238·71	20·70	324 78	1,321·51	Reserve, 20·70 acres unoccupied dry for grazing.
459·76	21·20	294·99	1,925·89	Do. 21·20 acres. do.
380·36	7·46	178·75	1,466·73	Do. 7·46 acres do.
1,346·52	23·62	439·88	2,325·79	Reserve, 20 acres unoccupied dry for grazing; 80 acres, forest.
817·65	58·02	220·99	1,359·73	Reserve, 58·02 acres unoccupied dry for grazing.
1,136·03	25·88	197·36	1,960·40	Do. 25·88 acrss do.
128·56	49·46	180·31	952·66	Do. 49·46 acres do.
187·57	85 14	34·97	307·68	Only small area commanded, no grazing reserve necessary.
85·92	0·85	226·43	1,362·06	Reserve, 0·85 acre unoccupied dry for grazing.
740·63	32·16	338·42	1,904·71	Do, 32·16 acres do.
813·30	14·37	157·01	1,318·70	Do. 14·37 acres do.
295·76	2·42	43·48	580·81	Do 2·42 acres do.
623·78	45·39	979·94	2,504·16	Do. 45·39 acres do.
663·04	18·75	60 74	742·53	Do. 18·75 acres do
409·21	50·48	106·77	699·17	Do. 50·48 acres do.
1,201·84	170·37	188·80	1,686·76	Do. 75 acres do
1,665·58	14·87	407·56	2,107·44	Do. 14·87 acres do.
680·82	..	43·72	724·54	....
1,377·18	119·51	246·95	1,904·54	Reserve, 75 acres unoccupied dry for grazing.
1,046·71	269·20	323·99	1,736·28	Do. 75 acres do.
2,067·04	1,236·27	380·81	3,794·80	Do. 150 acres do.
998·26	8·27	131·74	1,138·27	Do. 8·27 acres do.
690·17	162·28	77·39	929·84	Do. 75 acres do.
1,346·92	1,169·83	210·91	2,727·66	Do. 100 acres do.
30,522·46	5,676·21	10,706·63	59,987·92	

		ACS.	
Reserved unoccupied dry for grazing 1,236·31	.. ..	208·91	I.
		1,027·40	II.
		1,236·31	
Reserved forest	.. ..	1,244·70	

NOTE.—The II-D figures given now do not correspond with those given in K_1 statement (Report of 1905) as I had different areas given me then.

STATEMENT A.—Government areas—

Number. (1)	Name of village. (2)	Total area. (3)	Whole inam area. (4)	Minor inam area. (5)	Net Government area (column 3—columns 4 + 5). (7)	Area commanded. Wet. Occupied. (7)	Wet. Unoccupied. (8)	Dry. Occupied. (9)	Dry. Unoccupied. (10)
		ACS.	ACS.	ACS.	ACS.	ACS	ACS.	ACS.	ACS.
1	Toppuvidudi	1,758·51	Pudukkottai State. 31·58; Neduvasal Palayapet. 21 88	..; ..	1,705·05	99·77	2·02	893·07	182·34
2	Kavalipati	2,068·72	Pudukkottai State. 85·72; Neduvasal Palayapet. 36 51	6·02; ..	1,940·47	107·83	..	241·07	43·99
3	Kaduvettividudi	2,073·42	Pudukkottai State. 50·40; Neduvasal Palayapet. 43·72	10·50; ..	1,968·80	183 23	19 21	646·60	57·42
4	Pannikondanvidudi	1,106·71	..	..	1,106·71	118 39	..	648·92	75·89
5	Vettuvakottai	Neduvasal Palayapet. 2,844·70	109·02; Kalivarayanvidudi Palayapet 25·80	17·37; ..	2,692·51	33·05	7·74	2,098 75	195·50
6	Unjividudi	Neduvasal Palayapet. 2,138·67	130·14	9·41	1,999·12	189·94	0·85	1,314·39	179·64
7	Nambivayal	4,276·09	2,096·50	..	2,179·59	538·84	107·36	432·34	300 89
8	Virakkurichi	5,191·38	4,392·96	..	793·42	..	..	504 92	5·58
9	Sendankadu	2,480·46	847·36	1·94	1,631·16	191·22	0·22	1,185·68	73·50
10	Veppankulam	5,874 01	4,840·62	18·26	1,015·13	155·17	.	429·99	..
11	Alattur	4,598·40	3,757·44	29·87	811·09	97·02	..	591·32	8·01
12	Kannukudi (Kilpadi)	3,773·51	2,496·00	..	1,277·51	164·47	3·47	758·71	175·24
13	Kannukudi (Melpadi)	2,112 70	..	9·53	2,103·23	137·10	6·98	1,194·86	278·73
14	Tondarampattu	2,148·92	..	3·21	2,145·71	264·53	28·58	830·35	123·56
15	Avikkotai	7,130 55	6,261·76	1·10	867 69	91·46	8·47	625·06	81·82
16	Olaiyakunnam	2,782·85	675·20	5·22	2,102·43	504·51	246·92	622·40	280 47
17	Kanniyakurichi	5,535·28	4,704·11	14·46	816·71	384·85	83·57	135·99	1·09
18	Periakotai	1,778·61	..	11·46	1,767·15	678·37	9·22	581·46	109·59
19	Vattakudi	5,198·26	3,635·48	8·79	1,553·99	305·96	5·73	628·(8	21·58
20	Muttakurichi	1,784·99	..	4·98	1,780·01	35.81	3·82	1,274·38	72·96
21	Ponnavarayankottai	2,225·00	2,010·88	..	214·12	20·69	2·16	177 22	..
22	Anaikkadu	9,214·20	7,781·12	..	1,433·08	255·55	..	991·15	4·27
23	Pattukkottai	7,120·11	6,183·04	366·90	570·17	..	..	29·87	0·56
24	Kondikulam	4,117·46	3,637·76	..	479·70	3·64	..	317·82	55·01
25	Naduvikottai	1,592·21	..	6·24	1,585·97	176·66	1·83	786·43	132·01
26	Neiveli Vadapadi	1,848·73	12·25	5·08	1,831·40	193·30	0·94	782·21	31·34
27	Neiveli Tenpadi	1,785·04	..	4·86	1,780·18	3·84	..	547·74	30·86
28	Edaiyatti	3,061·94	257·60	..	2,804·34	788·07	136·26	887·78	144·37
29	Siruvavidudi Vadapadi	2,932·47	872·49	..	2,059·98	217·81	0·82	516·95	169 74
30	Neduvasal (Kilpadi)	2,237·72	613·45	..	1,624·27	427·12	124·87	420·44	13·46
31	Neduvasal (Melpadi)	1,512·82	..	1·47	1,511·35	..	..	25·94	..
34	Siruvavidudi Tenpadi	1,314·32	153·60	..	1,160 72	271·89	17 78	590 24	30·46
35	Tennankudi	4,757·50	4,398·72	..	358·78	71·48	..	215·92	1·39
36	Pudupattanam	17,606·89	17,338·24	..	268·65	37·79	5·12	93·87	57·14
39	Raghunadapuram	17,780 83	17,602·93	..	177·90	57·22	..	39·21	..
40	Mudapulikkadu	13,920·78	13,537·29	25·96	357·53	56·98	..	251·55	..
41	Pinnavasal Vadapadi	1,875·19	1,308·16	1·55	565·48	247·95	9·33	5·88	0·42
42	Pinnavasal Tenpadi	3,320 89	2,467·84	..	853·05	193·05	3·48	131·44	0 60
43	Marudangudi	13,084·92	11,967·25	11·53	1,106·14	216·59	0·75	415·31	10·97
61	Tuttakudi	6,969·74	5,578·56	4·62	1,386·50	228·30	35·27	102·24	49·28
62	Sittakanni	5,501·66	5,107·13	..	394·53	102·97	..	163 57	10 50
63	Kolakkudi	4,245·32	3,704·14	0·60	540·58	134·88	6·46	166·29	22·58
64	Perumagalur Vadapadi	3,534·81	2,146·54	13·05	1,375·22	516·88	18·72	806·72	25·40
65	Perumagalur Tenpadi	5,250·77	4,126·32	..	1,124·45	557·72	17·39	40 72	0·28
66	Valayanvayal	4,738·69	4,427·52	..	311·17	60·98	13·86	84·05	44·62
69	Tenaiyakudi	3,964·58	2,534·40	0 48	1,429·70	54·65	3·63	1·74	..
	Total ..	212,171·39	152,009·43	594·46	59,567,50	6,177·48	932·83	23,737·64	3,103·06

	Occupied.	Unoccupied.
	ACS.	ACS.
Total wet, class II non-delta	441·00	12·81
Do. III delta	849·19	149·33
Do. III non-delta	3,396·41	445·28
Do. IV	2,201·96	149·35
Do. V	2,288·92	176·06
Total ..	9,177·48	932·83

Pattukkottai taluk.

Poramboke.	Total of columns 7 to 11.	Area uncommanded.						Remarks.
		Wet.		Dry.		Poramboke.	Total of columns 13 to 17.	
		Occupied.	Unoccupied.	Occupied.	Unoccupied.			
(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)
ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	
144·42	1,321·62	..	..	366·67	7·07	9·69	383·43	
89·96	489 85	79·40	..	1,165·94	37·02	168·26	1,450·62	
180·22	1,086·68	..	..	748·63	99·52	33·97	382·12	
202·82	1,046·02	..	..	46·14	0·29	14·26	60·69	Reserve, 75·89 acres unoccupied dry for grazing.
305·10	2,640·14	..	..	51·44	..	0·93	52·37	Do. 100 acres do.
222·42	1,907·24	18 86	..	58·91	14 11	..	91·88	Do. 61 acres do.
629·04	2,008·47	..	..	166·15	..	4·97	171·12	
65·67	576·17	..	..	211·80	..	10·45	222·25	
180 54	1,631·16	..	..	..	..	..	..	Reserve, 73·50 acres unoccupied dry for grazing.
192·70	777·86	..	..	208·05	.	29·22	237·27	
114·74	811·09	..	..	..	..	..	..	Do. 8·01 acres do.
175·62	1,277·51	..	..	..	..	..	..	Do. 75·0 acres do.
485·56	2,103 23	..	..	..	..	..	..	244 acres forest.
477·23	1,724·25	..	..	363·04	10·71	47·71	421·46	
60·88	867·69	..	..	..	..	..	..	Reserve 75 acres unoccupied dry for grazing.
448 13	2,102·43	..	..	..	..	..	..	Do. 100 acres do.
211·21	816·71	..	..	..	..	..	..	Do. 1·09 acres do.
388·51	1,767·15	..	.	..	..	..	..	Do. 75 acres do.
226·05	1,187·40	..	..	342·98	0·70	22·91	366·59	
297·49	1,684·46	..	..	84·62	..	10·93	95·55	Reserve, 72·96 acres unoccupied dry for grazing.
14·05	214·12	..	..	..	..	..	..	
149·63	1,400·60	..	..	32·35	..	0·13	32·48	Reserve, 4·27 acres unoccupied dry for grazing.
15·53	45·96	10·57	..	331·07	8·23	174·34	524·21	
103·23	479·70	..	..	..	..	..	..	Reserve, 55·01 acres unoccupied dry for grazing
489·04	1,585·97	..	..	..	..	..	..	Do. 75 acres do.
299·03	1,306·82	6·25	0·24	443·35	4·43	70·31	524·58	
45·96	628·40	310·40	21·96	326·52	15·79	477·11	1,151·78	
676·70	2,633·18	..	..	165·81	.	5·35	171·16	
599·98	1,505·30	14·76	0·05	485·38	0·37	54·12	554·68	
150·13	1,136·02	47·54	0·28	346·28	2·48	91·67	488·25	
4·18	30·12	188·42	..	1,114·08	55·72	123·06	1,481·23	
250·35	1,160·72	..	..	..	..	..	..	Reserve, 22 acres unoccupied dry for grazing, jungle, 53 acres.
69·99	358·78	..	..	..	..	..	..	Reserve, 1·39 acres unoccupied dry for grazing.
74·73	268·65	..	..	..	..	..	..	Reserve, 57·14 acres unoccupied dry for grazing
81·47	177·90	..	..	..	..	..	..	
49·00	357·53	..	..	..	..	..	..	
301·90	565·48	..	..	..	..	..	..	Reserve, 0·42 acre unoccupied dry for grazing.
524·48	853·05	..	..	..	..	..	..	Do. 0·60 acre do.
255·84	899·46	55·53	26·75	18·68	..	105·72	206·68	Do. 10 97 acres do.
143·76	558·85	238·37	3·52	129·43	38·74	417·65	827·71	
57·68	334·72	2·10	..	55·63	..	2·08	59·81	Do. 10·50 acres do.
210 42	540·58	..	..	..	..	..	..	Do. 22·58 acres do.
450·30	1,318·02	..	..	37·87	18·33	1·00	57·20	Do. 25·40 acres do.
508·34	1,124·45	..	..	..	..	..	..	Do. 0·28 acre
107·66	311·17	..	..	..	..	..	..	Do. 44·62 acres do.
63·09	123·[illegible]1	458·71	5·35	129·41	26·16	686·96	1,306·59	
10,794·78	47,745·79	1,430·91	58·15	7,430·18	339·67	2,562·80	11,821·71	

				ACS.
Total commanded	unoccupied dry	reserved for grazing	.. ..	579·23
Do.	do.	forest	.. ..	304·01
Do.	do.	grazing ground	.. .. ..	20 23

STATEMENT A-1.—Alangudi taluk.

Number and name of village. (1)	(2)	Total area. (3)	Whole inam area. (4)	Minor inam area. (5)	Net State area—column 3—columns 4 + 5. (6)	Area commanded. Wet. Occupied. (7)	Area commanded. Wet. Unoccupied. (8)	Area commanded. Dry. Occupied. (9)	Area commanded. Dry. Unoccupied. (10)
		ACS.		ACS.	ACS	ACS.	ACS.	ACS.	ACS.
78	Mangadu ..	2,733·29	..	16·62	2,716·67	69·75	9·18	..	..
84	Kilatteru ..	2,638·33	..	10·26	2,628·07	392·42	20·05	35·40	..
85-A.	Kurumbivayal ..	778·48	..	15·98	762·50	70·85	49·11	6·99	10·55
85-B.	Ichchamviduthi ..	391·02	..	..	391·02	56·02	23·25	..	8·11
85-C.	Tirumananjeri ..	1,571·80	..	44 97	1,526·83	103·50	26·22	59·51	2·58
85-D.	Pattattikadu ..	1,175·02	..	..	1,175·02	128·17	192·99	45 48	0·70
90	Raghunathapuram.	1,263 99	..	17·36	1,246·63	207·62	0·08	3·76	..
91	Tattamanaipatti ..	520·84	..	..	520·84	106·39	4·13	14·02	5·51
92	Kirathur ..	778·38	..	4·95	773·43	460·12	8·32	60 37	0·31
93	Pappapatti ..	1,098·81	..	316·11	782·70	169·52	4·15	80 77	..
94	Puduviduthi ..	885·23	..	154·23	731·00	..	..	..	..
95	Kilangadu ..	1,126·47	..	60 93	1,065·54	289·33	51·25	375·14	1·88
96	Mudalipatti ..	681·76	..	..	681·76	192·51	5·94	159·51	4·64
97	Kallumadai ..	538·24	..	98·68	439·56	106·62	25.30	114 63	39·32
98	Sengamedu ..	1,703·86	..	220·00	1,483·86	298·54	12·32	499·52	102·13
98-A.	Tiruppakoil ..	101·83	..	..	101·83	26·90	0·33	19·28	5·26
99	Odappaviduthi ..	1,111·07	..	59·91	1,051·16	162·18	0·47	443·36	50·18
100	Peyadipatti ..	840·31	..	70·88	769·43	43·22	0·78	157·67	14 30
102	Sinnankanviduthi..	222·64	..	..	222·64	11·59	1·57	10·92	0·28
103	Karambaviduthi ..	864·92	..	..	864·92	..	..	..	..
106	Karambakudi ..	2,453·19	..	59·86	2,393·33	2·62	..	27·18	0·02
108	Tittanviduthi ..	788·98	..	6·66	782·32	14·26	10·31	47·76	7·00
109	Kolundirampattu ..	1,712·93	..	100·36	1,612·57	263·81	13·91	664·89	184·21
110	Ranjiyamviduthi ..	506·48	..	..	506·48	123·90	8·59	245·39	6·05
111	Kattatti ..	906·21	..	..	906·21	127·76	..	447·42	154·68
112	Kaliyoramviduthi..	435·18	..	..	435·18	180·96	..	158·47	10·94
	Total ..	27,829·26	..	1,257·76	26,571·50	3,608·56	468·25	3,677·44	608·65

Number and name of village.		Poramboke. (11)	Total of columns 7 to 11. (12)	Area uncommanded. Wet. Occupied. (13)	Area uncommanded. Wet. Unoccupied. (14)	Area uncommanded. Dry. Occupied. (15)	Area uncommanded. Dry. Unoccupied. (16)	Area uncommanded. Poramboke. (17)	Area uncommanded. Total of columns 13 to 17. (18)
		ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.
78	Mangadu ..	17·79	96·72	432·48	65·18	966·17	450·15	705·97	2,619·95
84	Kilatteru ..	1,201 55	1,649·42	46·34	..	664·01	..	268·30	978·65
85-A.	Kurumbivayal ..	557·27	694·77	7·12	..	..	5·05	55·56	67·73
85-B.	Ichchamviduthi ..	302·64	391·02	..	..	..	..	..	..
85-C.	Tirumananjeri ..	182·77	374·58	126·54	13·01	609·32	14·31	389·07	1,152·25
85-D.	Pattattikadu ..	194 85	562·19	19·31	0·82	436·33	8·51	147·86	612·83
90	Raghunathapuram.	41 24	252·70	554·52	2 07	87·23	..	350·11	993·93
91	Tattamanaipatti ..	156·60	286·65	132 89	..	26·45	17·15	57·70	234·19
92	Kirathur ..	244·31	773·43	..	..	..	..	..	..
93	Pappapatti ..	121·22	375·66	60·19	..	276·81	..	70·04	407·04
94	Puduviduthi ..	..	..	72·08	..	568·94	0·28	89·70	731·00
95	Kilangadu ..	333·91	1,051·51	2·19	..	11·84	..	..	14·03
96	Mudalipatti ..	314·22	676·82	..	..	4·94	..	..	4·94
97	Kallumadai ..	153·69	439·56	..	..	..	..	..	..
98	Sengamedu ..	476·41	1,388·92	7·63	..	82·87	..	4·44	94·94
98-A.	Tiruppakoil ..	50·06	101 83	..	..	..	..	..	..
99	Odappaviduthi ..	296·78	952·97	0 92	..	91·35	..	5·92	98·19
100	Peyadipatti ..	69·35	285·32	73·19	1·72	319·91	7·34	81·95	484·11
102	Sinnankanviduthi..	21·36	45·72	26·69	4·09	108·48	8·22	29·44	176·92
103	Karambaviduthi ..	..	..	181·79	3·52	514·56	32·30	132·75	864·92
106	Karambakudi ..	4·85	34·67	593·42	0·78	881·02	130·60	752·84	2,358·66
108	Tittanviduthi ..	2·52	81·85	207·26	1·22	325·88	20·55	145·56	700·47
109	Kolundirampattu ..	287 50	1,414·32	2·50	..	176·79	0·63	18·33	198·25
110	Ranjiyamviduthi ..	122·55	506·48	..	..	..	..	..	..
111	Kattatti ..	137·28	867·14	..	..	37·88	..	1 19	39·07
112	Kaliyoramviduthi..	84·81	435·18	..	..	..	..	..	..
	Total ..	5,376·53	23,739·43	2,547·06	92·14	6,190·78	695·09	8,306·73	12,832·07

Statement B.

Details of poramboke in Government villages—Tanjore taluk.

STATEMENT B.—Details of poramboke in Government

Number.	Name of village.	Poramboke area commanded.						
		Natham.	Road and Railway.	Tank.	River channel or drainage.	Forest.	Rock.	Grazing ground.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		ACS.	ACS.	ACS.	ACS.	ACS.		ACS.
10	Kadambangudi	1·00	2·87	58·35	1·57	..	..	..
12	Sholagampatti	..	0·49	0·14	7·25	16·00	..	..
13	Surakkudipatti	..	..	10·80	0·32	..	..	..
14	Kangiyampatti	237·31	64·22	88·06	17·05	..	..	..
15	Morneri	11·84	6·82	206·49	176·80	..	..	38·15
33	Nandavanapatti	4·43	52·49	24·36	19·86	..	..	..
34	Avarampatti	..	8·89	65·00	6·27	..	..	0·76
35	Budalur	..	6·48	0·52	0·08	..	..	..
36	Kovilpattu	0·96	10·25	69·32	1·31	..	..	..
37	Chitragudi	..	27·91	66·44	17·70	..	..	..
38	Royandur	25·12	2 62	217·08	36·92	..	..	3·21
58	Perambur, 1st setti	16·51	6 64	5·13	24·75	..	..	..
59	Do. 2nd setti	31·17	24·28	432·59	232 80	..	..	..
60	Kalivarayampettai	10·21	19·93	2·80	9·27	..	..	..
61	Alakkudi	43·09	35·58	0·11	40 89	..	..	7·40
62	Vennarapettai	44·27	38·00	25.41	131·56	..	..	..
63	Sakkarasamundam	16·62	10 09	14·77	67·14	..	..	..
64	Siralur	7·67	5·42	6·44	55·50	..	..	..
65	Pillaiyarnattam	18·67	5·77	3·24	133·91	..	..	..
123	Alangudi	..	10·24	2·80	2·03	..	..	..
124	Pulavanattam	8·23	12·10	13·05	2·04	..	..	..
125	Kumilakudi	..	3·75	..	0·75	..	..	..
126	Pundi	0·89	17·99	4·23	0·39	..	..	..
129	Saliyamangalam	28·15	52·82	75.16	60·00	..	..	..
130	Palliyur	0·47	6·50	30·39	7·81	..	..	..
132	Kilakovilpattu	41·64	40·54	152·38	83·83	..	..	..
133	Vadapadi	17·26	90·58	188·31	162·17	..	..	..
134	Puttur	17·32	45·98	50·20	20·22	..	..	..
135	Neduvasal	163·63	21·07	24·87	45·04	..	..	..
137	Puliyakudi	40·50	41·33	208·57	74·47	..	..	..
138	Arindavapuram	22·45	46·15	251·79	11·23	..	..	..
139	Kambayanattam	..	7·21	7·44	33 93	71·94	..	..
140	Tirupuvanam	15·82	21·75	18·77	34·72	..	..	..
141	Nallavunniyankudikadu	7·75	36 22	266·63	3·54	..	..	..
142	Raghavambalpuram	21·48	36·70	166·39	16·12	79·60	..	..
143	Murtiyambalpuram	25·47	36·06	159·29	4·08	78·36	..	..
144	Neivasal Tenpudi	7 58	27·44	151·94	77·79	14·26	..	..
145	Ponnappur kilpadi	74·44	10·25	365·05	27·11	157·68	..	..
146	Kulamangalam	67·89	1·80	603·14	35·12	..	..	..
147	Okkanadu Melaiyur	58·56	10 60	413·62	53·56	299·52	..	..
148	Okkanadu Kilaiyur	72 64	35·16	707·06	30·62	..	..	..
149	Kavarapattu	17·12	8 20	10·77	0 04	..	..	..
150	Arumulai	14 86	0·03	141 86	2·05	78·74	..	..
151	Tirumangalakottai Kilaiyur ..	46 78	13·48	182·43	33·84	611·59	..	..
152	Do. Melaiyur ..	23·13	9·74	426·69	28·62	..	..	..
153	Puvattur	31·64	19·28	456·58	139·91	217·64	..	68·68
154	Peikkarambankottai	20·27	19·36	94 93	16·93	..	..	..
155	Pulavangadu	10·99	15·88	112 50	0·29	..	..	..
156	Telungankudikadu	35·27	21·41	319·76	2·90	85·32	..	..
157	Kovilur	9·67	4·88	30·12	10·08	..	..	..
158	Palambuttur	16·36	46·99	268·25	11·54	..	..	..
159	Kakkarai	21·29	10·82	200·57	3·16	..	..	..
160	Kannandangudi Kilaiyur ..	29·90	14·05	418·23	29·58	193·20	..	..
161	Ponnappur Melpadi	24·08	9·14	103 63	3·80	..	..	..
162	Paruttikkottai	23·67	14·14	187·97	5 06	206·78	..	..
163	Ulur	30·86	15·88	286·36	3·33	..	..	..
164	Kila Ulur	27·48	4·25	42·15	4·43	..	..	..
165	Oondaiyaniruppu	24·22	20·94	66·65	..	28·67	..	..
166	Karammeidakottai	19·07	4·13	92·21	5 24	..	..	..
167	Jambugapuram	15·62	15·31	46·04	11·15	..	..	25·00
168	Paramudrakottai	8·83	35·60	45·82	22·26	..	..	..
169	Valamirankottai	27·75	4·34	103·07	5·21	..	..	..
170	Kattur	20·19	18·53	101·48	2·61	..	..	..
171	Madigai	15 93	19·84	97·74	13·41	..	..	..
172	Puduvur	35·81	10·39	145·15	7·69	8·00	..	..
173	Kattukurchi	14·77	5·15	176·79	8·17	..	..	..
174	Aliyavaikkal	39·92	62 35	132·45	17·47	2·58	..	..
175	Panchanadikottai	12·05	1·91	28·40	4·67	..	..	..
176	Karukkakottai	8·50	0·14	58·92	15·47	..	..	..
177	Ichchankottai 1st bit	..	5·84	9 77	6·18	..	..	..
178	Naduvur	..	..	..	..	..	..	..
183	Vallam Vadakkusetti	..	5·10	62·45	30·70	..	..	..
190	Vallam Pudursetti	..	..	..	4·72	..	..	..
192	Kuravadipatti	..	2·96	0·50	19·11	..	..	..
195	Viramarasampettai	..	..	29·38	8·38	..	..	..
211	Vendaiyampatti	..	..	..	..	..	..	..
	Total ..	1,786 88	1,381·05	9,637·76	2,245·92	2,149·88	..	143·20

villages—Tanjore taluk.

Miscella-neous.	Total of columns 3 to 10.	Poramboke area uncommanded.								
		Nattam.	Road and railway.	Tank.	River channel or drainage.	Forest.	Rock.	Grazing ground.	Miscella-neous.	Total of columns 12 to 19
(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.
0·83	64·62	3·74	8·36	86·91	46·71	..	..	..	0·19	144·91
..	23·89	..	23·26	757·60	16 42	565·95	..	..	26·48	1,389·71
..	11·12	..	24·58	702·77	38·72	..	..	101·34	..	867·41
..	406·64	3·21	11·23	406·49	161·55	..	..	..	0·66	583·14
2·68	442·78	..	..	3·0	..	..	..	..	..	3·00
8·81	109·95	7·69	1 36	671 21	73 93	..	..	..	1·52	755·71
2·73	83·65	52 80	4·97	155·79	1·96	..	..	17·80	0·38	233·70
6·55	13·63	27·55	54·63	41·0	246·97	..	..	..	16·08	386·23
0·07	81·91	22·49	13·19	92·39	17·19	..	..	..	1 14	146·40
0·75	112·80	24·15	46 21	164·83	38·10	..	..	..	12·32	285·61
8·18	293·13	..	..	..	202·89	..	..	5·47	7·14	215·50
7·80	60 83	..	..	..	..	..	..	..	..	..
11·0	731 84	..	..	..	..	..	..	..	..	..
3·81	46·09	..	29·59	19·45	6·09	..	..	..	0·43	55·56
0 95	128·02	1·10	65·03	..	11·95	..	..	6 73	0·44	85·25
18·28	257·52	..	36·23	5·45	26·19	..	..	..	3·08	70·95
1·77	110·39	..	..	..	..	..	..	..	..	..
7·41	82·44	..	..	..	..	..	..	..	..	..
8·38	169·97	..	..	..	..	..	..	..	..	..
6·59	21·66	20·50	2·56	112·46	68·11	..	..	..	5·92	209·55
0·49	35·91	13·56	0 79	..	52·16	..	..	..	14 81	81·32
..	4·50	29·90	1·48	40·18	101·39	..	..	..	0·53	173·48
2·20	25·70	43·42	24·46	142·91	57·68	..	..	..	9·69	278·16
19·31	235·44	..	..	..	..	..	..	..	..	..
..	45·17	25·50	17·59	39·49	88·80	..	..	..	19·36	190·74
13·64	332·03	..	..	..	..	..	..	..	..	..
5·15	463·47	..	..	..	..	..	..	..	..	..
5·54	139·26	..	..	..	..	..	..	..	..	..
75·31	329·92	..	..	..	..	..	..	..	..	..
79·09	443·96	..	..	..	..	..	..	..	..	..
7·42	339·04	..	..	..	..	..	..	..	..	..
0·15	120·67	..	12·19	141·39	8·20	..	..	..	19·83	181·61
5 48	96 54	..	..	..	..	..	..	..	..	..
1 57	315·71	..	..	..	3·17	..	..	..	0·06	3·23
13·28	333·57	1·43	0·96	..	..	220·73	..	..	0·17	223·29
16·78	319·84	..	..	..	..	..	..	..	..	..
334·70	613·71	..	..	..	..	..	..	..	..	..
12 96	647·49	4·50	..	..	..	..	..	..	..	4·50
2·46	710·41	0·14	1·43	..	..	..	..	..	4·98	6·55
25·03	860 89	..	..	..	..	..	..	..	..	..
47·42	892·90	..	..	..	..	..	..	..	..	..
1·66	37·79	..	..	..	..	..	..	..	..	..
4·35	241 89	..	..	..	..	..	..	..	..	..
5·50	893·62	..	..	..	..	..	..	..	..	..
13·87	502·05	..	..	..	..	..	..	..	..	..
11·92	945·65	..	..	..	..	..	..	..	..	..
34·61	186·10	..	..	..	..	..	..	..	..	..
5·81	145·47	..	..	..	..	..	..	..	..	..
14·64	479·30	..	..	..	..	..	..	..	..	..
95·21	149·96	2·77	1·40	..	..	..	..	..	2·91	7·08
3·52	346·66	..	..	..	..	..	..	..	..	..
11·32	247·16	..	..	..	..	..	..	..	..	
195·02	879·98	..	..	..	..	..	..	..	..	..
2·34	142·99	..	..	..	..	..	..	..	..	..
7·92	445·54	19·53	2·56	..	0·34	..	..	..	1·35	23·78
102·52	438·95	..	..	1·26	..	..	..	..	..	1·26
13·70	93·01	1·21	1·18	..	..	..	..	..	..	2·39
9·15	149·64	..	..	..	..	..	..	..	..	..
..	120·65	..	..	..	..	..	..	..	..	..
6·50	119 62	..	..	..	..	..	..	..	..	..
14·80	127·31	14·54	3·35	..	..	..	..	..	0 20	18·09
..	140·37	..	..	..	..	..	..	..	..	..
28·12	170 93	..	..	..	..	..	..	..	..	..
17·13	164·05	..	..	..	..	..	..	..	..	..
0·28	207·32	8·04	2·72	27·32	2·05	497·60	..	..	0·71	538·44
3·07	207·95	15·74	5·76	9·29	..	..	..	..	1·96	32·75
9·87	264·64	1·67	0·97	..	..	..	..	..	..	2·64
22·16	69·19	..	..	..	..	..	..	..	..	..
65·84	148·87	8·80	2·57	3·78	2·58	..	..	..	0·30	18 03
..	21·79	12·68	21·94	39·45	4·21	573·38	..	..	0·28	651·94
..	0·40	35·31	19·77	59·27	13·04	1,343·06	..	..	42·19	1,512·64
5·81	104·06	152·89	29·65	18·06	37·91	..	102·45	17·26	25 49	383·71
..	4·72	16·55	55·70	246·27	382·47	..	..	..	8·55	709·54
2·91	25·48	18·52	16·20	45·92	7·41	..	..	..	29·49	117·54
..	37·76	21·87	17·45	290·27	18·81	..	..	..	3·28	351·68
..	..	27·89	5·53	563·70	8·89	248·69	..	..	11·19	865·89
1,474·12	18,818·81	639·69	566·85	4,887·91	1,745·89	3,449·41	102·45	148·60	273·11	11,813·91

STATEMENT B.—Details of porambokes—Mannargudi taluk.

Number and name of village.	Poramboke area commanded.								
	Nattam.	Road and railway.	Tank.	River, channel or drainage.	Forest.	Rock.	Grazing ground.	Miscellaneous.	Total of columns 2 to 9.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	ACS.	ACS.	ACS.	ACS.	ACS.			ACS.	ACS.
1. Muvarkottai	4·82	47·26	159·02	118·74	..	..	..	17·73	347·57
2. Vaduvur Vadapadi ..	13·95	46·10	247 71	55·22	..	..	..	19·72	382·61
3. Edangakottai Melaiyur ..	12·62	50·96	275·55	33·62	261·14	..	..	69·57	703·46
4. Vaduvur Agraharam ..	40·47	12·72	374·68	38·22	..	..	..	2·41	468·50
5. Vaduvur Tenpadi	21·32	64·48	132·58	121·62	30·38	..	..	73·74	444·12
6. Peraiyur	25·60	57·00	253·23	90 85	693·93	..	..	67·33	1,187·94
7. Serumangalam	8·24	43·88	279·33	60·49	..	..	..	90·62	482·56
8. Mannargudi	180·06	83·17	40·71	14·52	..	..	..	61·34	379·80
10. Edangakottai Kilaiyur ..	6·55	21·83	217·50	75·60	178.50	..	..	13·40	513·38
11. Kalanjimodu	25·06	4·48	85·61	203·50	..	..	..	6·13	324·78
12. Rayapuram	7·39	36·81	52·76	182·61	..	..	..	15·42	294·99
15. Kalachcheri	17·72	17·99	29·79	79·50	..	..	..	33·75	178·75
16. Munnavalkottai	22·24	29·63	262·37	28·96	80·75	..	..	15·93	439·88
17. Adanur	19·02	72·50	70·80	41·46	..	..	..	17·21	220·99
18. Koyilvenni	51·25	56·65	27·32	43·95	..	..	..	18·19	197·36
19. Sittamalli Melpadi	24·54	20·89	7·75	112·44	..	..	..	14·69	180·31
126. Peruvalandan	5·62	0·57	16·51	9·60	..	..	..	2·67	34·97
127. Paliyur	54·78	6·77	20 96	135·08	..	..	..	8·84	226·43
128. Tenparai	58·67	37 40	118·65	126·86	..	..	..	16·84	338·42
129. Vallur	17·92	31·03	20·28	84·51	..	..	..	3·27	157·01
130. Maharajapuram	2·11	6·13	16·89	17·10	..	..	..	1·25	43·48
131. Tirumakkottai	30·13	16·49	29·84	891·48	..	..	..	12·00	979·94
132. Melanattam	9·61	14·70	20·42	4·79	..	..	..	11·22	60·74
133. Kandudampattu	4·07	15·77	80·96	3·70	..	..	..	2·27	106·77
134. Painganadu	24·08	32·23	86·39	36·48	..	..	..	9·62	188·80
135. Asesham	125·29	41·42	123·50	104·76	..	..	..	12·59	407·56
136. Gopralayam	...	14·79	7·99	8·64	..	..	..	12·30	43·72
137. Neduvakkottai	9·44	53 89	116·42	48·52	..	..	..	18·68	246·95
138. Pallakkudi	42·21	60·44	165·14	50·46	..	..	..	5·74	323·99
139. Ullikkottai	10·40	64·77	141·25	93·51	..	..	..	70·18	380·81
140. Mahadevapattanam ..	10·09	40·26	27·98	31·75	..	..	..	21·66	131·74
141. Nemmeli	16·07	10·63	31·30	17·15	..	..	..	2·24	77·39
142. Karuvakkurchi	53·36	16·14	39·09	76·26	..	..	..	26·06	210·91
Total ..	934·70	1,129·69	3,580·98	3,041·95	1,244·70	..	..	774·61	10,706·63

Poramboke commanded area according to A Register is 10,706·63 acres.

STATEMENT B.

DETAILS of porambokes in Government areas—Pattukkottai taluk.

STATEMENT B.—Details of porambokes in Government

Number and name of village.		Poramboke area commanded.						
		Nattam.	Road and railway.	Tank.	River channel or drainage.	Forest.	Rock.	Grazing ground.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
		ACS.	ACS.	ACS.	ACS.	ACS.		ACS.
1	Toppaviduthi	13·09	8·58	111·60	7·93	..	..	..
2	Kavalipatti	13·25	9·45	49·23	0·50	..	..	..
3	Kaduvettividudi	4·87	2·30	163·46	4·93	..	..	..
4	Pannikondanvidudi	5·79	28·08	132·76	34·92	..	..	..
5	Vettuvakottai	32·58	26·20	239·14	2·60	..	..	..
6	Unjividudi	20·71	11·17	119·52	53·80	..	..	..
7	Nambivayal	7·15	30·28	443·00	117·67	..	..	..
8	Virakurchi	..	17·46	33·28	2·94	..	..	..
9	Sendagadu	4·62	20·05	89·35	41·81	..	..	..
10	Veppankulam	0·59	14·69	145·20	10·60	..	..	..
11	Alathur	33·95	13·61	50·28	5·45	..	..	..
12	Kannukudi Kilpadi	14·31	6·69	126·67	11·27	..	..	..
13	Kannukudi Melpadi	21·24	9·69	149·53	23·11	244·60	..	..
14	Tondarampatti	12·39	3·11	406·99	29·31	6·40	..	..
15	Avikkottai	6·00	11·26	36·67	3·53	..	..	..
16	Olaiyakkunnam	11·60	6·13	328·54	100·81	..	..	..
17	Kaniyakurichi	18·83	4·18	164·25	16·89	..	..	..
18	Periyakottai	13·80	14·83	282·65	69·86	..	..	..
19	Vattagudi	1·26	1·90	211·61	4·63	..	..	..
20	Muttakurichi	8·20	25·56	244·13	8·91	..	..	..
21	Ponnavarayankottai	5·33	5·32	3·40	..	..	..	..
22	Anaikkadu	1·45	13·16	107·85	12·85	..	..	..
23	Pattukkottai	3·31	6·28	5·94	..	..	..	..
24	Kondikulam	4·04	13·11	62·88	21·25	..	..	..
25	Naduvakottai	9·58	11·80	446·37	2·06	..	..	..
26	Neiveli Vadapadi	11·61	8·55	220·81	15·13	..	..	20·23
27	Neiveli Tenpadi	0·87	1·55	43·54	..	..	..	..
28	Edaiyatti	19·58	5·35	363·86	223·25	..	..	..
29	Seruvadidudi Vadapadi	0·35	8·62	513·79	24·95	..	..	..
30	Neduvasal Kilpadi	3·90	1·93	136·59	1·68	..	..	..
31	Neduvasal Melpadi	..	..	3·43	0·75	..	..	..
34	Seruvavidudi Tenpadi	12·67	23·03	91·20	9·86	53·01	..	..
35	Tennangudi	7·67	3·10	58·75	..	..	..	..
36	Puduppatnam	9·14	5·03	38·18	4·90	..	..	..
39	Raghunathapuram	1·00	9·77	70·66	0·04	..	..	..
40	Mudappulikadu	..	23·78	22·21	1·94	..	..	..
41	Pinniavasal Vadapadi	5·09	8·00	267·09	6·60	..	..	..
42	Pinniavasal Tenpadi	5·02	5·17	497·48	9·58	..	..	..
43	Marudangudi	1·34	15·99	133·00	96·16	..	..	..
61	Tuttagudi	..	0·03	108·44	32·04	..	..	..
62	Sittakanni	0·09	0·15	50·09	1·62	..	..	..
63	Kolakudi..	4·35	10·75	176·20	6·72	..	..	..
64	Perumaghalur Vadapadi ..	24·22	7·39	396·91	18·77	..	..	..
65	Perumaghalur Tenpadi	21·38	6·40	461·52	16·50	..	..	..
66	Valayanvayal	..	0·15	98·60	6·36	..	..	..
69	Tenaiyakudi	..	..	55·66	6·83	..	..	..
	Total ..	396·22	459·63	7,959·89	1,074·40	304·01		20·23

areas—Pattukkottai taluk.

		Poramboke area not commanded.								
Miscellaneous.	Total.	Nattam.	Road and railway.	Tank.	River channel or drainage.	Forest.	Rock.	Grazing ground.	Miscellaneous.	Total.
(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.			ACS.	ACS.
3·22	144·42	3·98	0·28	4·70	..	..	..	..	0·73	9·69
17·53	89·96	24·12	17·57	87·10	..	..	..	..	38·47	168·26
4·66	180·22	16·31	2·57	13·82	..	..	..	..	1·27	33·97
1·27	202·82	12·40		0·50	..	..	..	..	1·36	14·26
4·58	305·10	..	0·68	..	..	..	..	..	0·25	0·93
17·22	222·42	..	..	..	..	..	..	..	..	..
30·94	629·04	1·52	..	2·45	..	..	..	..	1·00	4·97
11·39	65·67	..	10·45	..	..	..	..	..	..	10·45
21·71	180·54	..	..	..	..	..	..	..	..	..
21·62	192·70	3·53	5·19	20·50	..	..	..	..	..	29·22
11·45	114·74	..	..	..	..	..	..	..	..	..
16·68	175·62	..	..	..	..	..	..	..	..	..
37·39	485·56	..	..	..	..	..	..	..	..	..
19·03	477·23	11·09	6·29	25·73	..	..	..	..	4·60	47·71
3·42	60·88	..	..	..	..	..	..	..	..	..
1·05	448·13	..	..	..	..	..	..	..	..	..
7·06	211·21	..	..	..	..	..	..	..	..	..
7·36	388·51	..	..	..	..	..	..	..	..	..
6·65	226·05	10·84	5·56	0·85	0·10	..	..	..	5·56	22·91
10·69	297·49	1·09	3·73	6·11	..	..	..	..	..	10·93
..	14·05	..	..	..	..	..	..	..	..	..
14·32	149·63	..	0·13	..	..	..	..	..	..	0·13
..	15·53	97·48	29·42	45·66	0·30	..	..	..	1·48	174·34
1·95	103·23	..	..	..	..	..	..	..	..	..
19·23	489·04	..	..	..	..	..	..	..	..	..
22·70	299·03	27·15	9·21	28·55	0·06	..	..	..	5·34	70·31
..	45·96	14·50	18·79	8·69	147·54	..	..	..	287·59	477·11
64·66	676·70	3·35	2·00	..	..	..	..	..	..	5·35
52·27	599·98	20·75	5·97	5·27	0·24	..	..	..	21·89	54·12
6·03	150·13	31·58	4·73	46·65	8·71	..	..	..	..	91·67
..	4·18	14·92	1·47	85·83	8·77	..	..	..	12·07	123·06
60·58	250·35	..	..	..	..	..	..	..	..	..
0·47	69·99	..	..	..	..	..	..	..	..	..
17·48	74·73	..	..	..	..	..	..	..	..	..
..	81·47	..	..	..	..	..	..	..	..	..
1·07	49·00	..	..	..	..	..	..	..	..	..
15·12	361·90	..	..	..	..	..	..	..	..	..
7·28	524·48	..	..	..	..	..	..	..	..	..
9·35	255·84	..	..	91·12	13·32	..	..	..	1·28	105·72
3·25	143·76	5·16	30·23	361·60	5·53	..	..	..	15·13	417·65
5·73	57·68	0·04	0·55	0·80	0·22	..	..	..	0·47	2·08
12·40	210·42	..	..	..	..	..	..	..	..	..
5·98	450·30	..	..	1·00	..	..	..	..	..	1·00
2·45	508·34	..	..	..	..	..	..	..	..	..
2·55	107·66	..	..	..	..	..	..	..	..	..
0·60	63·09	10·20	6·55	478·21	83·72	103·68	..	..	4·60	686·96
580·40	10,794·78	310·01	161·37	1,315·14	269·61 * 268·51	103·68	..	..	403·09	2,562·80

* Correct total.

STATEMENT C.—Natham statement—Tanjore taluk.

Number and name of village. (1)	(2)	Population of village. (3)	Number of houses in the village. (4)	Present natham area commanded. (5)	Entire area required for future extension of natham area. (6)	Number and area of fields in commanded area reserved for natham. Survey number. (7)	Area.	Remarks. (8)
				ACS.	ACS.		ACS.	
10	Kadambangudi.	557	92	1·01	1·00	194	0·42	The main village-site is very constricted and requires extension. It borders on the new irrigation but is itself surrounded by wet fields and there is no dry land for extension. Tondarampatti field, No. 194, unoccupied dry, is the only one available for extension and will be reserved. There will still be high dry land to the west of the village which should be acquired and used.
12	Sholagampatti ..	795	133	..	..	..	..	No reservation called for in the commanded area.
13	Surakkudipatti.	518	88	..	..	..	..	Commanded area wholly away from natham.
14	Kangyampatti.	1,344	234	237·31	..	..	..	In this village natham and tanks have been classed together and survey No. 282, classed as Kangyampatti natham, measuring 231·90 acres, is mostly tank. The main village and one hamlet Vinnanurpatti are in the commanded area. The main village is surrounded by tank and wet land and there is no possibility of extension. Vinnanurpatti is surrounded on three sides by wet fields and the railway on the fourth. There is no way of providing for a dry belt. There is plenty of scope in the uncommanded area for extension of hamlets there and for new village-sites.
15	Maraneri ..	860	144	11·84	..	..	..	....
33	Nandavanappatti.	1,040	165	4·43	5·00	215, 217–20	5·00	Main village-site is not commanded. It will be sufficient to reserve 5 acres in the fields noted in column (7) which are partly natham and partly occupied dry.
34	Avarampatti ..	928	149	..	..	..	..	No reservation required.
35	Budalur ..	2,205	333	..	2·00	554	2·00	The hamlet Ambalagarantheruvu is in survey No. 554, measuring 10·76 acres, and all are occupied, 64 cents being wet and the rest dry. I think 2 acres in this field will be sufficient for extension and dry belt. I should recommend that it be marked out, subdivided and irrigation prohibited.
36	Kovilpatti ..	1,198	190	0·96	3·00	161–3, 165–8	3·00	Only one paracheri hamlet is commanded in this village, but it is close to the main village which is itself surrounded by wet fields. The paracheri is surrounded by occupied dry fields Nos. 161–3 and 165–8 totalling about 6 acres, out of which the necessary 3 acres will have to be subdivided and irrigation prohibited.
37	Chitragudi ..	1,342	218	..	..	..	..	No reservation required.
38	Rayandur ..	1,398	201	25·12	..	..	..	Do.
58	Perambur, 1st Setti.	..	..	16·51	..	..	..	Do.
59	Perambur, 2nd Setti.	1,094	199	31·17	..	..	..	Do.
60	Kalivarayampettai.	774	108	10·21	..	..	..	Do.
61	Alakkudi ..	1,453	249	43·09	..	..	..	Present natham sufficient for future needs.
62	Vennarapettai ..	1,103	172	44·27	..	..	..	Do.
63	Sekkarasammandam.	778	127	16·62	..	..	..	Do.
64	Siralur	367	58	7·67	..	..	..	Do.
65	Pillaiarnatham.	1,159	191	18·67	13·00	..	..	....
123	Alangudi ..	624	128	..	..	..	..	No reservation required.
124	Pulavanatham ..	654	117	8·23	..	..	..	Present natham is ample.
125	Kamilakkudi ..	662	120	..	..	..	..	No reservation required.
126	Pundi	2,319	409	0 89	10·00	354 414, 415	7·00 3·00	Only two paracheris are commanded in survey Nos. 414 and 416. Pundi itself will probably spread into survey No. 354—10·40 acres—which is commanded. I think it advisable to reserve 7 acres of this for extension of Pundi and 3 acres in 413 and 415 for extension of the paracheri.
129	Saliyamangalam.	1,305	232	28·15	..	..	..	Present natham sufficient for future needs.
130	Palliyur ..	1,514	257	0·47	3·00	309, 391, 393, 396.	3·00	One paracheri in commanded area. Nos. 389, 391, 393 and 396 are mainly occupied dry.
132	Kilakoilpattu ..	956	196	41·64	..	..	..	Present natham ample for future needs.

Statement C.—Natham statement—Tanjore taluk—*cont.*

Number and name of village. (1)	(2)	Population of village. (3)	Number of houses in the village. (4)	Present natham area commanded. (5)	Entire area required for future extension of natham area. (6)	Number and area of fields in commanded area reserved for natham. Survey number. (7)	Area.	Remarks. (8)
				ACS.	ACS.		ACS.	
133	Vadapadi ..	976	164	17·26	13·0	5, 8, 10	2·0	The fields in column (7) are partly natham and partly occupied dry.
						31, 34–6, 38	4·0	
						200–2	1·0	
						256	3·0	
						208, 214, 212, 217, 220	3·0	
							13·0	
134	Puthur ..	1,089	209	17·32	4·0	83, 84, 86, 88	1·0	Do. do.
						119, 121, 130–2	2·0	
						296–8, 331, 333–5	1·0	
							4·0	
135	Neduvasal ..	5,260	968	163·63	..	..	..	Present natham enough for future needs.
137	Puliyakudi ..	1,916	304	40·50	8·0	20, 22, 24	1·0	The fields in column (7) are partly natham and partly occupied dry.
						58	1·0	
						98	2·0	
						125	1·0	
						210	1·0	
						290	2·0	
							8·0	
138	Arindavapuram.	2,034	321	22·45	17·0	79, 80	5·0	Do do.
						91, 96, 98	3·0	
						103, 105, 109	2·0	
						152, 156, 158	4·0	
						178, 179		
						217, 99	2·0	
						300, 302–3, 307	1·0	
							17·0	
139	Kambayanatham.	1,504	251	..	26·0	23, 25, 34, 37, 39	20 0	Do do.
						56, 58	6·0	
							26·0	
140	Tiruppuvanam.	1,162	160	15·82	3·0	29, 30, 42, 46	2·0	Do. do.
						108	1·0	
							3·0	
141	Nallavanniyan-kudikadu.	1,250	191	7·75	20·0	4, 9, 11, 18	1·0	Village wholly commanded. Present nathams measure 7·75 acres. Future requirements calculated with reference to existing area of each natham. Reserved area all occupied dry.
						70, 72, 74	3·0	
						87, 102, 104, 105	9·0	
						126, 128, 133	3·0	
						80, 81, 129	4·0	
							20·0	
142	Raghavambal-puram.	2,591	403	21·48	..	....	..	There is a total natham area of 185 acres in this village which is ample for future needs.
143	Mrthiyambal-puram.	1,793	274	25·27	..	....	..	There is a total natham area of 33 acres; ample for future needs.
144	Neivasal Tenpadi.	1,420	203	7·58	35·0	28, 39, 40, 42, 52, 53	20·0	The fields in which areas have to be reserved are mostly occupied dry.
						125, 126, 128–30	7·0	
						153–5, 161, 162, 164	2·0	
						163, 172, 175, 186	6·0	
							35·0	
145	Ponnapurkilpadi.	1,311	207	74·44	..	..	..	Present area ample for future needs.
146	Kulamangalam.	1,209	146	67·8	..	..	..	Do.
147	Okkanadu Melaiyur.	1,917	282	58·56	..	..	..	Do.

Statement C.—Natham statement—Tanjore taluk—*cont.*

Number and name of village. (1)	(2)	Population of village. (3)	Number of houses in the village. (4)	Present natham area commanded. (5)	Entire area required for future extensions of natham area. (6)	Number and area of fields in commanded area reserved for natham. Survey number. (7)	Area.	Remarks. (8)
				ACS.	ACS.		ACS.	
148	Okkanadu Kilaiyur.	2,382	325	72·64	..	..	..	Present area ample for future needs.
149	Kavarappattu ..	760	109	17·12	..	..	..	Do.
150	Arumulai ..	730	124	14·86	..	..	..	Do.
151	Thirumangala-kottai Kilaiyur.	1,609	229	46·78	..	..	..	Do.
152	Thirumangala-kottai Melaiyur.	1,096	186	23·13	37·0	57	1·0	The fields in column (7) are partly natham and partly occupied dry.
						64	2·0	
						76	4·0	
						84	1·0	
						110	2·0	
						112	5·0	
						113, 115	11·0	
						116, 123	2·0	
						133	2·0	
						137	3·0	
						144	4·0	
							37·0	
153	Puvathur ..	1,495	205	31·64	..	..	..	Existing natham sufficient for future needs.
154	Pekkarumban-kottai.	898	116	20·27	..	..	..	Do. do.
155	Pulavankadu ..	788	108	10·99	5·0	26	2·50	The fields in column (7) are partly natham and partly occupied dry.
						32	2·50	
							5·00	
156	Telungankudik-kadu.	1,258	171	35·27	..	..	..	Present area sufficient for future requirements.
157	Kovilur ..	509	116	9·67	15·0	75, 77, 91, 93, 94, 96, 98	12·0	The fields noted in column (7) are mostly occupied area.
						15, 17	3·0	
							15·0	
158	Palamputtur ..	951	149	16·36	4·0	26, 27	2·50	Do. do
						69–71	1·50	
							4·0	
159	Kakkarai ..	772	103	21·29	3·0	57–59	2·0	Do. do.
						74, 76	1·0	
							3·0	
160	Kannandangudi Kilaiyur.	1,553	215	29·90	3·0	137	1·0	Do do.
						170	1·0	
						175	1·0	
							3·0	
161	Fonnappur Melpadi.	1,432	205	24·08	..	..	..	Practically all the natham is main village-site. It is ample for future requirements.
162	Paruthikottai ..	1,384	207	23·67	..	..	..	The present extent of natham is ample for this village and will be wholly reserved.
163	Ulur	..	..	30·86	..	..	..	The present extent of natham is ample for future requirements.
164	Kila Ulur ..	1,310	188	27·48	..	..	..	The present extent of natham is ample for future needs.
165	Vandiyaniruppu.	854	124	24·22	..	..	..	Do. do.
166	Karumundak-kottai.	714	92	19·07	..	..	..	Do. do.
167	Jambugapuram.	..	..	15·62	..	..	..	Do. do.
168	Raramudri-kottai.	1,501	220	8·83	19·0	9, 10	10·0	The fields in column (7) are mostly occupied dry.
						141	4·0	
						23	3·0	
						79	2·0	
							19·0	
169	Valamirian-kottai.	986	138	27·75	..	..	..	The existing natham is ample for future requirements.
170	Kattur ..	999	140	20·19	..	..	..	Natham ample for future requirements.

Statement C.—Natham statement—Tanjore taluk—*cont.*

Number and name of village. (1)	(2)	Population of village. (3)	Number of houses in the village. (4)	Present natham area commanded. (5)	Entire area required for future extensions of natham area. (6)	Number and area of fields in commanded area reserved for natham. Survey number. (7)	Area.	Remarks. (8)
				ACS.	ACS.		ACS.	
171	Madigai ..	940	138	15·93	3·0	2 53 59 95 98 99	0·20 0 50 0·30 0·50 1·0 0·50 3·0	Fields in column (7) are partly natham and partly occupied dry.
172	Buduvur ..	1,836	239	35·81	..	..	..	Natham enough for future needs.
173	Kattukurichi ..	1,105	170	14·77	7·0	37 70, 72 138	2·0 1·0 4·0 7·0	Fields in column (7) are partly natham and partly occupied dry.
174	Aliyavaikal ..	2,074	315	39·92	..	..	..	Natham enough for future needs.
175	Panchanadi-kottai.	686	97	12·5	..	..	..	Do.
176	Karukkakottai.	920	724	8·50	4·50	60–62, 67,69, 101	4·50	The fields named are mostly occupied dry and the area of 4·50 acres is available for reserving dry.
177	Ichchankottai 1st bit.	851	112	..	..	..	..	No natham commanded and it is unnecessary to reserve any of the commanded area.
178	Naduvur ..	1,337	159	..	..	..	..	Do. do.
183	Vallam Vadakku Setti.	7,590	1,175	..	..	..	..	Do. do.
190	Vallam Pudur Setti.	794	128	..	..	..	..	Do. do.
192	Kuruvadipatti..	675	108	..	..	..	..	Do. do.
195	Viramarasam-pettai.	474	86	..	..	..	..	Do. do.
	Total ..			1,786·32			249·92	3 × 1,786 + 4 × 250 = 6,358 acres.

Statement C.—Natham statement—Mannārgudi taluk.

Number of village. (1)	Name of village. (2)	Population of village. (3)	Number of houses in the village. (4)	Present natham area commanded. (5)	Area required for future extension of natham and dry belt in the commanded area. (6)	Fields reserved for natham and dry belt. Survey number. (7)	Fields reserved for natham and dry belt. Area.	Remarks. (8)
				ACS.	ACS.		ACS.	
1	Muvarkottai ..	897	135	4·82	24	70, 72, 77, 79 247, 249 368 391, 399	7 7 3 7 24	The fields in column (7) are mostly occupied dry.
2	Vaduvur Vadapadi ..	3,206	498	13·95	38	30, 32 42 63 89 242, 252, 246, 248–9 266, 267 270, 275 286 399 418, 420 436	3 3 2 1 12 5 5 1 1 4 1 38	Do. do.
3	Edangankottai Melaiyur.	2,101	325	12·62	28	98, 100, 102, 104–106, 110 109, 112, 114 200, 202 220, 222, 225, 228 233, 235, 212, 213 239, 243 298	7 4 2 2 9 3 1 28	Do. do.
4	Vaduvur Agraharam.	1,045	197	40·47	..	....	..	Present natham sufficient for future needs.
5	Do. Tenpadi ..	2,429	395	21·32	27	12 17 32, 35, 38 356, 360	5 4 10 8 27	Fields in column (7) mostly occupied dry.
6	Peraiyur	1,890	334	25·60	35	210, 211, 218 285, 289 318, 322 415, 425, 426 466, 468 546, 551	4 3 5 17 2 4 35	Do. do.
7	Sirumangalam ..	1,550	260	8·24	38	64, 66, 70, 72, 73, 122, 125, 126, 130, 140 141, 144 208	29 7 2 38	Do. do.
8	Mannargudi	20,449	3,672	180·06	..	....	..	Present natham sufficient for future needs.
10	Edangankottai Kilaiyur.	1,703	276	6·55	34	155, 216 214 273, 274, 282, 297 310, 312	17 3 14 34	Fields in column (7) mostly occupied dry.
11	Kalanjimodu ..	1,026	202	25·06	..	....	..	Present natham sufficient for future needs.
12	Rayapuram	1,439	258	7·39	25	379, 381, 384, 387	20 5 25	The paracheri survey No. 423, where 5 acres extension will be required, is at present surrounded with wet fields. Five acres may be selected somewhere else.

Statement C.—Natham statement—Mannārgudi taluk—*cont.*

Number of village.	Name of village.	Population of village.	Number of houses in the village	Present natham area commanded.	Area required for future extension of natham and dry belt in the commanded area.	Fields reserved for natham and dry belt. Survey number.	Area.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)
				ACS.	ACS.		ACS.	
15	Kalacheri	1,231	214	17·72	7	124, 142, 148	1	Fields in column 7 are mostly occupied dry.
						344, 354	2	
						531	1	
						537, 538	3	
							7	
16	Munavalkottai ..	1,700	286	22·24	14	144, 148, 156, 158	7	
						243	5	
						371	2	
							14	Do. do.
17	Adanur	1,024	162	19·02	3	110, 118	2	
						251	1	
							3	Do. do.
18	Koilvenni	1,970	331	51·25	..	....	..	Present natham sufficient for future needs.
19	Sittamalli Melpad ..	1,417	258	24·54	..	....	..	Do. do.
126	Peruvalndan	3,762	785	5·62	..	....	..	Only a very small part of this village is commanded; no reason to extend natham.
127	Palaiyur	1,196	242	54·78	..	....	..	Present natham sufficient for future needs.
128	Tenparai	1,950	338	38·67	..	....	..	Do. do.
129	Vallur	1,186	218	17·92	5	56, 58, 60	2	
						73	2	
						227, 230	1	
							5	Fields in column 7 mostly occupied dry.
130	Maharajapuram ..	560	106	2·11	8	113, 114	2	
						123, 124	3	
						133	3	
							8	Do. do.
131	Tirumakkottai ..	984	179	30·13	..	....	..	Present natham sufficient for future needs.
132	Melanatham	1,062	215	9·61	3	36, 43	1	
						71, 73	2	
							3	Fields in column 7 mostly occupied dry.
133	Kanduthampatti (Kuppachchikottai).	536	101	4·07	8	86	8	Do. do.
134	Painganadu	2,066	354	24·08	6	141, 142	1	
						155	4	
						179, 181	1	
							6	Do. do.
135	Asesham	689	135	125·29	..	....	..	Present natham sufficient for future needs.
136	Gopralayam	213	44	..	14	43—8	14	This village has no natham poramboke. It borders on Mannargudi; 14 acres may be left as dry in the fields in column 7 which abut on the Mannargudi road.
137	Neduvaakkottai ..	1,755	298	9·44	23	241, 248, 254	15	
						356	8	
							23	The fields in column 7 are mostly occupied dry.
138	Pallakkudy	2,096	373	42·21	..	....	..	Present natham sufficient for future needs.

Statement C.—Natham statement—Mannārgudi taluk—*cont.*

Number of village. (1)	Name of village. (2)	Population of village. (3)	Number of houses in the village. (4)	Present natham area commanded. (5)	Area required for future extension of natham and dry belt in the commanded area. (6)	Fields reserved for natham and dry belt. Survey number. (7)	Fields reserved for natham and dry belt. Area.	Remarks. (8)
				ACS.	ACS.		ACS.	
139	Ullikkottai	3,558	588	10·40	56	77, 83, 151	12	Fields in column 7 are mostly occupied dry.
						336, 344—6	30	
						353	4	
						446, 456, 458, 459	10	
							56	
140	Mahadevapatnam ..	1,824	319	10·09	10	88, 117	3	Do. do.
						128	3	
						296	2	
						302	2	
							10	
141	Nemmeli	819	129	16·07	..	....	..	Present natham sufficient for future needs.
142	Karuvakurichi ..	2,137	344	53·36	..	....	..	Do. do.
	Total ..	..	..	934·70	406	....	406	3 × area in column 5 + 4 × area in column 7 = 3 × 935 + 4 × 406 = 2,805 + 1,624 = 4,429 acres.

STATEMENT C.—Natham statement—Pattukkōttai taluk.

Number of village. (1)	Name of village. (2)	Population of village. (3)	Number of houses in village. (4)	Present natham area commanded. (5)	Area required for future extension of natham. (6)	Number and area of fields in commanded area reserved for natham. Survey number. (7)	Area.	Remarks. (8)
				ACS.	ACS.		ACS.	
1	Toppuviduthi ..	1,802	237	13·09	7·0	20, 37,49	3·0	Fileds in column 7, partly poramboke and partly occupied dry.
						135, 138—40	2·0	
						160	2·0	
							7·0	
2	Kavalipatti	1,361	269	13·25	..	....	..	Present natham sufficient for future needs.
3	Kaduvetividuthi ..	1,849	277	4·87	..	....	..	Do.
4	Pannikondanviduthi.	664	123	5·79	..	....	..	Do.
5	Vettuvakkottai ..	2,162	394	32·58	14·0	53, 61	1·0	Fields in column 7 mostly occupied dry.
						64	2·0	
						66	2·0	
						225	4·0	
						220, 240	3·0	
						285	1·0	
						336	1·0	
							14·0	
6	Unjividuthi	1,238	227	20·71	14·0	26, 28	2·0	Do.
						32, 34	1·0	
						63	1·0	
						134, 137	5·0	
						151, 155	5·0	
							14·0	
7	Nambivayal	692	128	7·15	15·0	60, 63	15·0	Only 15 acres necessary as part of natham in 200 is on high uncommanded ground.
8	Virakkurchi ..	537	95	..	..	....	..	Plenty of dry uncommanded land for village site. Patta land used for village site.
9	Sendangadu	805	144	4·62	24·0	22	6·0	Fields in column 7 mostly occupied dry.
						53, 55	6·0	
						69	6·0	
						72	6·0	
							24·0	
10	Veppankulam .	421	69	4·12	12·0	....	..	Most of the natham is in uncommanded area and there is plenty of dry area for extension there.
11	Alathur	1,507	302	33·95	..	....	..	Present natham sufficient for future requirements.
12	Kannukudi Kilapathi.	646	88	14·31	8·0	37, 39, 83, 93	3·0	Fields in column 7 mostly occupied dry.
						42, 44	1·0	
						102, 103	4·0	
							8·0	
13	Kannukudi Melpathi.	1,439	200	21·24	11·0	51, 53, 54, 57	3·0	Do.
						66	4·0	
						122	1·0	
						143	1·0	
						148	1·0	
						153	1·0	
							11·0	
14	Tondarampattu ..	1,093	179	12·39	..	....	..	Present natham sufficient for future needs.
15	Avikottai	350	59	6·0	10·0	46	2·0	Fields in column 7 mainly occupied dry.
						80, 81, 84, 86	6·0	
						93	2·0	
							10·0	
16	Olaiyakunnam ..	500	88	11·60	21·0	87, 89, 93,113	17·0	Do.
						142, 143	4·0	
							21·0	
17	Kaniyakurichi ..	605	121	18·83	..	....	..	Present natham sufficient for future needs.

Statement C.—Natham statement—Pattukkōttai taluk—*cont.*

Number of village.	Name of village.	Population of village.	Number of houses in village.	Present natham area commanded	Area required for future extension of natham.	Number and area of fields in commanded area reserved for natham.		Remarks.
						Survey number.	Area.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)
				ACS.	ACS.		ACS.	
18	Periyakkottai ..	1,282	247	1,380	15·0	165 181, 182 254	5·0 4·0 6·0 15·0	Fields in column 7 mainly occupied dry.
19	Vattagudy	870	170	1·26	6·0	35, 38 69, 81	3·0 3·0 6·0	Do.
20	Muttakurchi	1,609	303	8·20	19·0	91, 92, 95 120, 122 195	11·0 4·0 4·0 19·0	Do.
21	Ponnavarayankottai.	525	85	5·33	..	....	..	Present natham sufficient for future needs.
22	Anaikadu	1,007	184	1·45	23·0	11, 14 180, 184	15·0 8·0 23·0	Fields in column 7 mainly occupied dry.
23	Pattukkottai	7,504	1,393	3·31	..	....	..	Present natham sufficient for future needs.
24	Kondikulam	306	32	4·04	4·0	3 5, 6	1·0 3·0 4·0	Fields in column 7 mostly occupied dry.
25	Nuduviakottai ..	882	178	9·58	13·0	143—5 146	11·0 2·0 13·0	Do.
26	Neiveli Vadapathi ..	1,897	379	11·61	..	....	..	Present natham sufficient for future needs.
27	Do. Tenpathi ..	789	175	0·87	..	....	..	Do.
28	Edaiyatti	2,118	413	19·58	16·0	23 68, 71, 73, 82 58 129 245 355 368, 370, 371	1·0 8·0 1·0 1·0 1·0 1·0 3·0 16·0	Fields in column 7 mostly occupied dry.
29	Seruvaviduthi Vadapathi.	928	208	0·35	..	....	..	Present natham sufficient for future needs.
30	Neduvasal Kilpathi ..	1,576	308	3·90	..	....	..	Do.
31	Do. Melpathi.	894	152	..	..	....	..	Do.
34	Servaviduthi Tenpathi.	768	172	12·67	6·0	19, 22 24 37 42	1·0 2·0 2·0 1·0 6·0	Fields in column 7 mostly occupied dry.
35	Tennangudi	362	72	7·67	..	....	..	Present natham sufficient for future needs.
36	Puduppatnam ..	641	101	9·14	..	....	..	Do.
39	Raghunathapuram ..	74	15	1·00	1·0	4	1·0	Field in column 7 is mainly occupied dry.
40	Mudappulikkadu ..	95	21	..	6·0	....	6·0	No recognized natham in this village. Any area of 6 acres may be selected.
41	Pinnavasal Vadapathi.	166	29	5·09	..	....	..	Present natham sufficient for future needs.
42	Pinnavasal Tenpadi.	385	65	5·02	1·0	28	1·0	Field in column 7 mostly occupied dry.
43	Maruthangudi ..	91	18	1·34	11·0	2, 3	11·0	Do.

Statement C.—Natham statement—Pattukkottai taluk—*cont.*

Number of village. (1)	Name of village. (2)	Population of village. (3)	Number of houses in the village. (4)	Present natham area commanded. (5)	Area required for future extension of natham. (6)	Number and area of fields in commanded area reserved for natham. Survey number. (7)	Area. (8)	Remarks. (9)
				ACS.	ACS.		ACS.	
61	Tuttagudi	247	61	..	3·0	....	..	The natham of this village is not commanded and the extension will not come out of the commanded area.
62	Sittakanni	105	18	0·09	4·0	1	4·0	Field in column 7 mostly occupied dry.
63	Kolakudy	197	44	4·35	2·0	24—7	2·0	This natham is partially surrounded by wet fields. Only 3 acres dry available in the neighbourhood. Bits of whole fields occupied dry.
64	Perunagalur Vadapathi.	743	154	24·22	..	...	..	Present natham sufficient for future needs
65	Perunagalur Tenpadi.	520	92	21·38	..	....	..	Do.
								No recognized natham in this village. Four acres may be selected anywhere.
66	Valaiyanvayal ..	35	6	..	4·0	..	4·0	No natham commanded. Present natham sufficient for future needs.
69	Tennanhudi	373	79	..	..	....	..	3 × column 5 + 4 × column 7 = 1,200 + 1,020 = 2,220 acres.
	Total ..	..	..	399·75	..	....	255·0	

STATEMENT D for inams (major and minor), shrotriem, zamin, etc., Tanjore taluk.

Number of village. (1)	Name of village. (2)	Total area. (3)	Area commanded. Wet occupied. (4)	Area commanded. Dry occupied. (5)	Area commanded. Balance. (6)	Area commanded. Total. (7)	Area not commanded. Wet occupied. (8)	Area not commanded. Dry occupied. (9)	Area not commanded. Balance. (10)	Area not commanded. Total. (11)
	Entire inams.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.
24	Palliyeri	587·40	196·61	276·32	114 47	587·40	..	..	..	..
25	Ramanadapuram ..	2,867·16	..	308·35	49·46	357·81	..	..	..	2,509·35
32	Palayinayal inam ..	161·59	69·17	28·09	64·33	161·59	..	..	..	..
74	Chantram Pudur ..	1,541·55	92·84	851·72	596·99	1,541·55	..	..	..	..
75	Muktambalpuram ..	574·02	..	403·43	170·59	574·02	..	..	..	..
76	Kannandangudi Melanyur	2,498·62	217·75	1,604·60	676·27	2,498·62	..	..	..	..
77	Thennamanadu ..	3,309·62	484·70	2,041·74	763·18	3,309·62	..	..	..	..
78	Kandudampath 2nd portion.	826·45	284·51	251·87	290·07	826·45	..	..	..	..
79	Velarkasba Thottam ..	4,761·06	..	1,837·82	341·24	2,179·06	..	..	..	2,582·00
82	Lakshatope	2,893·20	..	23·31	1·36	24·67	..	..	..	2,868·53
123	Emunambalpettai .. attached to Alangudi.	0·42	..	..	0·42	0·42	..	..	..	..
	Pumanallur attached to Alangudi.	12·60	..	..	12·60	12·60	..	..	..	..
135	Mahinnalai attached to Neduvasal.	16·27	..	16·27	..	16·27	..	..	..	..
139	Suliyakottai attached to Kambayanathan.	743·50	..	..	..	..	..	..	..	743·50
140	Jambiyammalpuram attached to Tirupuram	2,446·14	144·10	2,067·32	234·72	2,446·14	..	..	..	..
146	Talavamangalam attached to Kulamangalam.	1,013·71	62·73	730·39	220·59	1,013·71	..	..	..	..
147	Entire inam attached to Okkanadu Melaiyur.	7·52	..	..	7·52	7·52	..	..	..	..
148	Do. Kelaiyur.	12·45	12 45	..	..	12·45	..	..	..	..
156	Do. Telungankudikadu.	2·20	..	..	2·20	2·20	..	..	..	..
161	Do. Ponnapur Melpathi.	3·17	3·17	..	..	3·17	..	..	..	..
162 & 164	Paruthiyapparkovil attached to Kila Ulur.	354·63	0·40	228·00	7·12	235·52	..	..	..	119·11
168	Kulichapathu (attached to Raramudrakottai)	26·09	..	23·01	3·08	26·09	..	..	..	..
	Kathminatham. (attached to Raramudrakottai)	586·42	..	517·46	68·96	586·42	..	..	..	..
	Thalavar Palayam (attached to Raramudrakottai)	554·50	77·81	394·93	81·76	554·50	..	..	..	..
174	Entire inam attached to Aliyavaikal.	70·22	17·04	53·18	..	70·22	..	..	..	..
177	Samipath attached to Ichchamkottai.	536·79	..	..	..	..	..	..	..	536 79
	Total ..	26,407·30	1,663·28	11,657·81	3,726·93	17,048·02	..	..	..	9,359·28
	Minor inams.									
10	Kadambangudi ..	1·18	..	..	..	..	..	1·18	..	1·18
15	Maraneri	0·66	..	..	..	..	..	0·66	..	0·66
35	Budalur	0·93	..	..	..	..	0·65	0 28	..	0·93
36	Kovilpattu	2·59	..	..	..	..	..	2·59	..	2·59
37	Chitragudi	4·09	..	..	..	..	..	4·09	..	4·09
58	Perambur 1st Setti ..	24·75	24·75	..	..	24·75	..	..	..	..
59	Do. 2nd Setti ..	1·02	..	1·02	..	1·02	..	..	..	..
62	Vennarapettai	0·25	..	0·25	..	0·25	..	..	..	..
77	Thennamanadu entire inam.	13·53	..	13·53	..	13 53	..	..	..	..
123	Alangudi	97·42	..	91·08	..	91·08	3·49	2·85	..	6·34
124	Pulavanatham	10·01	..	10·01	..	* 10·01	..	..	..	..
126	Pundi	0·64	..	..	..	..	..	0·64	..	0 64
129	Saliyamangalam ..	31·15	3·15	28·00	..	31·15	..	..	..	..
130	Pallivur	0·85	..	..	..	..	..	0·85	..	0·85
132	Kilakovilpattu	147·11	..	126·44	..	126·44	..	20·67	..	20·67
134	Puthur	118·81	..	116·81	..	116·81	..	2·00	..	2·00
135	Neduvasal	71·91	..	66 65	..	66·65	..	5·26	..	5·26
137	Puliyakudi	32·58	..	32·58	..	32·58	..	..	..	..
138	Arindavapuram ..	37 01	..	33·96	..	33·96	3 05	..	..	3·05
139	Kambayanatham ..	0·51	..	0·51	..	0·51	..	..	..	..
140	Thiruppuvanam ..	9·64	..	9·64	..	9·64	..	..	..	..
141	Nallavanniyankudikadu.	4·32	..	4·32	..	4·32	..	..	..	..

* Forms ilupai tope.

Statement D for inams (major and minor), shrotriyam, zamin, etc., Tanjore taluk—*cont.*

Number.	Names of villages.	Total area.	Area commanded. Wet occupied.	Area commanded. Dry occupied.	Area commanded. Balance.	Area commanded. Total.	Area not commanded. Wet occupied.	Area not commanded. Dry occupied.	Area not commanded. Balance.	Area not commanded. Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	Minor inams—cont.	A (	ACS.	ACS.		ACS.	ACS.	ACS.		ACS.
142	Raghavambalpuram ..	29·86	..	29·86	..	29·86	..	..	..	..
143	Murthiyambalpuram ..	12·52	..	12·52	..	12 52	..	..	..	..
144	Neivasal Thenpathi ..	7·18	..	7·18	..	7·18	..	..	..	..
145	Ponnapurkilpathi ..	3 10	..	3·10	..	3·10	..	..	..	..
146	Kulamangalam ..	24·83	..	24·83	..	24·83	..	..	..	..
147	Okkanadu Melaiyur ..	13·82	..	13·82	..	13·82	..	..	..	..
148	Do. Kilaiyur ..	2·23	..	2 23	..	2·23	..	..	..	..
149	Kavarapettu ..	4·05	..	4·05	..	4 05	..	..	..	..
150	Arumalai	8·00	..	8·00	..	8·00	..	..	..	..
151	Thirumangalakottai Kilaiyur.	7·72	..	7·72	..	7·72	..	..	..	..
152	Thirumangalakottai Melaiyur.	14·67	..	14·67	..	14·67	..	..	..	..
154	Peikarambankottai ..	0·64	..	0·64	..	0·64	..	..	..	..
156	Telungankudikadu ..	4·19	..	4·19	..	4·19	..	..	..	..
157	Kovilur	56·46	..	16·62	..	16·62	..	39·84	..	39·84
158	Palamputhur	3·63	..	3·63	..	3·63	..	..	..	..
159	Kakkarai	1·40	..	1·40	..	1·40	..	..	..	..
160	Kamandangudi Kilaiyur.	14·06	6·15	7·91	..	14·06	..	..	..	..
161	Ponnappur Melpathi ..	1·75	..	1·75	..	1·75	..	..	..	..
162	Parithikottai	..	..	..	..	..	..	..	..	..
164	Kila Ulur	15·05	13·08	0·95	..	14·03	..	1·02	..	1·02
168	Raramudrikottai ..	21·92	..	21·92	..	21·92	..	..	..	..
169	Valamirankottai ..	11·61	..	11 61	..	11·61	..	..	..	.
172	Puduvur	63·94	..	1·00	..	1·00	..	62·94	..	62·94
173	Kattukurichi ..	39·56	..	6·00	..	6·00	..	33·56	..	33·56
174	Aliyavaikkal ..	0·64	..	0·64	..	0·64	..	..	..	..
177	Ichchankottai 1st bit ..	29·57	..	1·85	..	1·85	..	27·72	..	27·72
178	Naduvur	12·98	..	..	..	..	..	12·98	..	12·98
183	Vallam Vadakku Sethi.	95·14	..	..		..	..	95·14	..	95·14
190	Vallam Pudur Sethi ..	50·14	..	..	..	..	32·83	17·31	..	50·14
192	Kuruvadipatti ..	3·09	..	..	..	..	..	3·09	..	3·09
195	Veeramarasampettai ..	1·42	..	..	..	..	..	1·42	..	1·42
211	Vendayampatti ..	2·81	..	..	..	..	..	2·81	..	2·81
	Total ..	1,168·94	47·13	742·89	..	790·02	40·02	338·90	..	378·92

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Enclosure 8 to Tanjore D register—Zamin area.

Number as shown in taluk map.	Name of zamin.	Minor village or hamlet included.	Total area as taken out from 2" map.	Area not commanded.	Area commanded. Wet.	Area commanded. Tank bed.	Area commanded. River.	Area commanded. Net dry area.
			ACS.	ACS.	ACS.	ACS.	ACS.	ACS.
83	Gandharvakottai zamin second part.	..	12,120	3,070	370	180	55	8,445
85	Konur	..	1,764	264	..	20	..	1,480
..	Kallakkottai	..	6,280	* 5,485	..	† 75	..	† 720
	Total ..	..	20,164	8,819	370	275	55	10,645

* Area west of line. † Area east of line.

STATEMENT D for inams (minor and entire), Mannargudi taluk.

Number. (1)	Names of villages. (2)	Total area. (3)	Area commanded. Wet occupied. (4)	Dry occupied. (5)	Balance. (6)	Total. (7)	Area not commanded. (8)
		ACS.	ACS.	ACS.	ACS.	ACS.	ACS.
	Entire inam.						
5	Karakottai	1,067·40	356·11	601·06	110·23	1,067·40	..
12	Kilpati	187·79	..	92·68	4·00	96·68	91·11
	Shrotriyam	201·65	..	..	..	..	201·65
15	Mokhasa	77 80	..	62·73	..	62·73	15·07
	Chetti chattram	741·20	327·79	249·68	163·73	741·20	..
16	Pittum inam	93·40	85·00	5·60	2·80	93·40	..
	Shonapattai Thattimal	154·32	..	15t·32	..	154·32	..
19	Entire inam	167 57	..	..	..		167·57
7	Attikottai	473·40	122·90	287·50	63·00	473·4C	..
8	Mannargudi	23·20	..	..	..	..	23·20
9	Muvanallur	5,586·60	1,099·02	*3,568·76	918·82	5,586·60	..
17	Adanur	1 19	..	..	..	..	1·19
127	Palayakottai Palasapuram	828·34	429·21	345·86	53·27	828·34	..
129	Radhanarasimhapuram	951·38	323·12	556·87	71·39	951·38	..
131	Perumalkovil nattam	583·14	159·87	405·96	17·31	583·14	..
133	Rajasambalpuram	790·55	36·87	580·00	..	616 87	173·68
	Paravakottai	2,416·61	..	1,470·00	..	1,470 00	946·61
	Nana Sahib tottam	614·82	..	366·64	..	366·64	248·18
140	Mokhasa	40 98	..	..	..	..	40·98
	Choultry	1·80	..	..	..	..	1·80
	Semdarakottai	720·63	..	496 08	..	496·08	224·55
134	Edayar nattam	700·73	..	662·89	..	662·89	37·84
	Tulajendrapuram	1,883·59	217·91	681·41	..	899·32	984·27
139	Ullikottai	146·42	..	..	..	..	146·42
	Total ..	18,454·51	3,157·80	10,588·04	1,404·55	15,150·39	3,304·12
	Minor inam.						
1	Muvarkottai	..	..	..	..	..	..
2	Vaduvur Vadapadi	28·13	..	28·13	..	28 13	..
3	Edangankottai Melaiyur	7·72	..	7·72	..	7·72	..
4	Vaduvur Agraharam	0·60	..	0·60	..	0·60	..
5	Do. Tenpathi	4·01	..	4·01	..	4·01	..
6	Peraiyur	69·95	..	69·30	..	69·30	0·65
7	Serumangalam	62·14	..	62·14	..	62·14	..
8	Mannargudi	318·24	..	127·53	..	127·53	190·71
10	Edangankottai	6·51	..	6·51	..	6·51	..
11	Kalanjimedu	50·23	50·18	0·05	..	50·23	..
12	Rayapuram	55·11	51·81	3·30	..	55·11	..
15	Kalacheri	30·74	..	1·38	..	1 38	29·36
16	Munnavalkottai	75·20	..	75·20	..	75·20	..
17	Adanur	71·90	..	71·90	..	71·90	..
18	Kovilvenni	80·81	..	71·71	..	71·71	9·10
19	Sittamalli Melpadi	17·37	17·37	·	..	17·37	..
126	Peruvaladan	461·36	..	..	..	..	461·36
127	Palaiyur	134·58	8·39	..	..	8 39	126·19
128	Tenparai	2·37	..	2·37	..	2·37	..
129	Vallur	41·86	36·86	5 00	..	41·86	..
130	Maharajapuram	23·59	7·93	..	..	7·93	15·66
131	Tirumolkottai	198·33	182·86	15·47	..	198·33	..
132	Melanattam	6·77	..	6·77	..	6·77	..
133	Kanduthampattu	0·80	..	0·80	..	0·80	..
134	Painganadu	13·12	..	13·12	..	13 12	..
135	Asesham	105·06	5·62	99·44	..	105·06	..
136	Gopralayam	3·78	..	3·78	..	3·78	..
137	Neduvokottai	73·17	6 88	66·29	..	73·17	..
138	Pallakkudi	28·22	..	25·72	..	25·72	2·50
139	Ullikkottai	185·14	..	126 40	..	126·40	58·74
140	Mahadevapatnam	294·88	..	294·88	..	294·88	..
141	Nemmeli	2·68	..	..	..	..	2·68
142	Karuvakuruchi	34 73	..	32·93	..	32·93	1·80
	Total ..	2,489·10	367·90	1,222·45	..	1,590·35	898·75

* 2,595·92 dry ; 972·84 manavari.

Statement D for inams (major and minor), shrotryams, zamins, etc., Pattukkottai taluk.

Number.	Names of villages.	Total area.	Area commanded.				Area not commanded.			
			Wet occupied.	Dry occupied.	Balance.	Total.	Wet occupied.	Dry occupied.	Balance.	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		ACS.	ACS.	ACS.	ACS.	ACS.				
7	Nambivayal inam villages—									
	Talikaividuthi	1,147·38	58·42	880·23	208·73	1,147·38	..	..	..	..
	Suriyamurthipuram	238·08	107 33	54 66	76·09	238·08	..	..	..	..
	Veppankadu	711·04	52·55	550 52	107·97	711·04	..	..	..	..
	Total ..	2,096·50	218·30	1,485·41	392·79	2,096·50	..	..	..	..
8	Virukuruchi inam villages—									
	Sukkarampatti	424·96	99·64	228 64	96·68	424·96	..	..	..	..
	Aladikkumili	718·72	85·86	557·31	75·55	718·72	..	..	..	..
	Palamuthi	858·24	121·65	569 30	167·29	858·24	..	..	..	..
	Sandakadu	703·36	..	639 83	63·53	703·36	..	..	..	..
	Surapallam	1,491·20	422·57	697·04	371·59	1,491·20	..	..	..	..
	Medayakollai	196·48	..	190·86	5·62	196·48	..	..	..	..
	Total ..	4,392·96	729·72	2,882·98	780·26	4,392·96	..	..	..	..
9	Sendankadu inam village—									
	Tittakudi	847·36	34·88	698·87	113·61	847·36	..	..	..	..
10	Veppankulam inam villages—									
	Musiri	342·40	..	322·37	20·03	342·40	..	..	..	..
	Adampallam	955·41	169·25	688·35	97·81	955·41	..	..	..	..
	Talikottai	867·84	153·71	614·79	99·34	867·84	..	..	..	..
	Nathussalai	1,481·60	248·12	1,147·77	8[illegible]·71	1,481·60	..	..	..	..
	Attikkottai	1,193·37	340·90	649·76	202·71	1,193·37	..	..	..	..
	Total ..	4,840·62	911·98	3,423·04	505·60	4,840·62	..	..	..	..
11	Alattur inam villages—									
	Mahadevapuram	777·60	97 51	556·72	123·37	777·60	..	..	..	..
	Mullerpattikadu	675·84	79·19	511 22	85·43	675·84	..	..	..	..
	Vadakankuttagai	742·40	40·39	633·67	68·34	742·40	..	..	..	..
	Sembalur	821·12	122·57	565·70	132·85	821·12	..	..	..	..
	Ettipulikadu	575·36	..	557·64	17 72	575·36	..	..	..	..
	Sonakarambai	165.12	99·56	52·42	13·14	165·12	..	..	..	..
	Total ..	3,757 44	439·22	2,877·37	440·85	3,757·44	..	..	..	..
12	Kannakudikilapadi inams—									
	Karuppur	1,219·20	288·11	723·76	207·33	1,219·20	..	..	..	..
	Poravattur	796·80	197·18	477·98	121·64	796·80	..	..	..	..
	Kodigalur	480·00	86·98	316·64	76·38	480·00	..	..	..	..
	Total ..	2,496·00	572·27	1,518·38	405·35	2,496 00	..	..	..	..
15	Arikottai inams—									
	Kilakurichi	2,143·36	418·73	1,587·25	137·38	2.143·36	..	..	..	..
	Nemmeli..	732·80	284·94	303·69	144·17	732·80	..	..	..	..
	Andami	1,338·07	478·32	506·72	353·03	1,338·07	..	..	..	..
	Pulavanji	1,189·29	134·67	1,001·11	53·51	1,189·29	..	..	..	..
	Movur attached to Kannangudi Kilpathi	858·24	99·79	582·87	175·58	858·24	..	..	..	..
	Total ..	6,261·76	1,416·45	3,981·64	863·67	6,261·76	..	..	..	..
16	Olaiyakunnam inam village—									
	Kalyana odai	675·20	124·96	409·97	140 27	675·20	..	..	..	..
17	Kaniyakundi inams—									
	Kalichchankottai	296·32	83·61	179·24	33·47	296·32	..	..	..	..
	Sokkanoor	1,196·16	760·19	271·79	164·18	1,196·16	..	..	..	..
	Puliyakudi	581·76	325·33	139·54	116·89	581·76	..	..	..	..
	Madherabhasharipuram ..	539·71	196·41	248·95	94·35	539·71	..	..	..	..
	Kadandangudi	1,488·45	753·95	525·68	208·82	1,488·45	..	..	..	..
	Korappanpadu	596·24	234·83	229·92	131·49	596·24	..	..	..	..
	Motodayan	5·47	5·47	..	..	5·47	..	..	..	..
	Total ..	4,704·11	2,359·79	1,595·12	749·20	4,704·11	..	..	..	..
19	Vattagudi inams—									
	Elangadu 1st bit	741·76	331·53	294·04	116·19	741·76	..	..	..	..
	Do. 2nd bit	153·60	59·16	33 64	60·80	153·60	..	..	..	..
	Vattagudi Ukkadai	735·36	159·20	352·36	228·80	735·36	..	..	..	..
	Raghunathapuram	204·80	43·87	126·38	34·55	204·80	..	..	..	..
	Porakalakottai	1,083·20	314·54	489·30	279·36	1,083·20	..	..	..	..
	Krishnapuram	561·24	171·88	322·51	66·85	561·24	..	..	..	..
	Parasuramandal	85·12	31·24	25·87	28 01	85·12	..	..	..	..
	Elangadu Kottayam	70·40	55·42	..	14 98	70·40	..	..	..	..
	Total ..	3,635·48	1,166·84	1,644·10	824·54	3,635·48	..	..	..	..

Statement D for inams (major and minor, shrotriyams, zamins, etc., Pattukkottai taluk—*cont.*

Number.	Names of villages.	Total area.	Area commanded. Wet occupied	Dry occupied.	Balance.	Total.	Area not commanded. Wet occupied.	Dry occupied.	Balance.	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		ACS.	ACS.	ACS.	ACS.	ACS.				
21	Ponnavarayankottai inams—									
	Ponnavarayakottai Ukkadai ..	691 84	150·50	371·76	169·58	691·84	..	..	..	..
	Vendakottai	712·32	191·47	438·89	81·96	712·32	..	..	..	..
	Pappavali Palayakottai ..	606·72	191·97	279·40	135·35	606·72	..	..	..	..
	Total ..	2,010·88	533·94	1,090·05	386·89	2,010·88	..	..	..	..
22	Anaikadu inams—									
	Tevarankuruchi	2,948·48	859·23	1,553·97	535·28	2,948·48	..	..	..	..
	Pulankanni	152·32	42·20	69·67	40·45	152·32	..	..	..	..
	Mudelicheri	927·36	215·59	600·57	111·20	927·36	..	..	..	..
	Pallikondan	1,170·56	334·55	654·96	181·05	1,170·56	..	..	..	..
	Sendakottai	2,582·40	822·56	998·42	766·42	2,582·40	..	..	..	..
	Total ..	7,781·12	2,274·13	3,872·59	1,634·40	7,781·12	..	..	..	..
24	Kondrakalam inams—									
	Tamaraimadai and Virattavayal	514·56	149·14	195·48	169·94	514·56	..	..	..	..
	Kelayapulikadu	702·72	40·90	564 26	97·56	702·72	..	..	..	..
	Pillankuli	223·36	172·08	1·18	50·10	223·36	..	..	..	..
	Manavayal	456·96	269·32	63·80	123·84	456 96	..	..	..	..
	Talavayal	176·00	144·86	2·32	28·82	176·00	..	..	..	..
	Ennaivayal	359·68	193·73	43·62	122·33	359·68	..	..	..	..
	Eduthathivayal	280·96	63·87	122·16	94·93	280·96	..	..	..	..
	Naivavuduthi	821·92	125·40	120·46	76·06	321·92	..	..	..	..
	Anandiswarapuram	486·40	245·66	64·10	176·64	486·40	..	..	..	..
	Sundaranayakipuram	115·20	5·14	105·30	4·76	115·20	..	..	..	..
	Total ..	3,637·76	1,410·10	1,282·68	944·98	3,637·76	..	..	..	..
28	Edayathi inams	257·60	..	216·10	41·50	257·60	..	..	..	..
29	Servaviduthi vadapathi inams—									
	Muttiapuram	13·14	13·14	..	..	13·14	..	..	..	..
	Suryanarayanapuram	323·20	102·71	139·70	80·79	323·20	..	..	..	..
	Krishnapuram	536·15	362·83	85·46	87·86	536·15	..	..	..	..
	Total ..	872·49	478·68	225·16	168·65	872·49	..	..	..	..
30	Neduvasal kilpathi inams—									
	Balakrishnapuram	27·85	9·34	12·62	5·89	27·85	..	..	..	..
	Mudukkavayal	585·60	254·70	197·25	133·65	585·60	..	..	..	..
	Total ..	613·45	264·04	209·87	139·54	613·45	..	..	..	..
32	Lakshminarasimapuram inams—									
	Pulichchangadu 1st bit ..	624·00	111·77	455·24	56·99	624·00	..	..	..	..
	Do. 2nd bit ..	178·00	178·00	..	..	178·00	..	..	..	..
	Karambaikadu	676·48	153·63	367·14	155·71	676·48	..	..	..	..
	Seriyalur	652·16	126·98	395·72	129·46	652·16	..	..	..	..
	Total ..	2,130·64	570·38	1,218·10	342·16	2,130·64	..	..	..	..
33	Andavarayapuram inams—									
	Settiandal	231·04	70·22	115·82	45·00	231·04	..	..	..	..
	Perianakapuram	1,489·92	600 25	562·89	326·78	1,489·92	..	..	..	..
	Sinnarasalur	137·60	34·15	74·22	29·23	137·60	..	..	..	..
	Anandavallipuram Palayanagrams, Arasalamkarambai.	1,843·84	357·62	974·47	511·75	1,843·84	..	..	..	..
	Tondipulikadu	319·36	..	319·36	..	319·36	..	..	..	..
	Total ..	4,021·76	1,062·24	2,046·76	912·76	4,021·76	..	..	..	..
34	Seruvaviduthi Thenpatti inams—									
	Krishnapuram	153·60	34·06	86·01	33·53	153·60	..	..	..	..
35	Tennangudi inams—									
	Valudalaimadam	492·16	214·57	106·73	170·86	492·16	..	..	..	..
	Kalliuranikkadu	416·00	33·44	356·88	25·68	416·00	..	..	..	..
	Madattukkodu	551·04	69·54	425·22	56·28	551·04	..	..	..	..
	Turanikkadu	743·68	84·58	601·85	57·25	743·68	..	..	..	..
	Unsetiled inam	178·42	..	..	178·42	178·42	..	..	..	..
	Total ..	2,381·30	402·13	1,490·68	488·49	2,381·30	..	..	..	..
[illegible]	Pudupatnam shrotriems—									
	Velinayal	442·24	247·52	76·96	117·76	442·24	..	..	..	..
	Kollukkadu	1,375·36	474·24	408 40	492·72	1,375·36	..	..	..	..
	Sinna Avidayakovil	1,484·80	638·23	493·08	353·49	1,484·80	..	..	..	..

Statement D for inams (major and minor), shrotriyams, zamins, etc., Pattukkóttai taluk—*cont.*

Number of village.	Name of village.	Total area.	Area commanded.				Area not commanded.			
			Wet occupied.	Dry occupied.	Balance.	Total.	Wet occupied.	Dry occupied.	Balance.	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		ACS.	ACS.	ACS.	ACS.	ACS.				
36	Pudupatnam shrotriyams—*cont.*									
	Andikkadu	954·24	155·79	669·36	129·09	954·24	..	..	..	..
	Ettinayal	533·12	235·14	149·38	148·60	533·12	..	..	..	..
	Maravannayal	300·80	223·43	34·39	42·98	300·80	..	..	..	..
	Kallinayal	263·68	190·52	7·46	65·70	263 68	..	..	..	..
	Kallinayal Thottam	146·56	..	139·13	7·43	146·56	..	..	..	..
	Karisavoyal 1st bit	479·36	44·64	381·31	53·41	479·36	..	..	..	..
	Karisavoyal 2nd bit ..	73·60	..	70·14	3·46	73·60	..	..	..	..
	Avodayanvoyal . ..	115·84	39·93	54·72	21·19	105·84	..	..	..	..
	Pidariyal	236·16	25·08	155·13	55·95	236·16	..	..	..	..
	Maruthangavayal	563 84	266·49	135·45	161·90	563·84	..	..	..	..
	Rendampulikkadu	480 00	47·94	295·41	136·65	480·00	..	..	..	..
	Alagianayakipuram	409·60	179·11	97·57	132·92	409·00	..	..	..	..
	Udayanudayon	224·00	..	215·72	8·28	224·00	..	..	..	..
	Sinnathamaraivoyal	54·40	5·10	43·07	6·23	54·40	..	..	..	..
	Pallattur	1,541·12	700·09	540 10	300·93	1,541·12	..	..	..	..
	Sokkanadapuram	1,984·88	633·22	838·45	513·21	1,984·88	..	..	..	..
	Pukkarambai	1,228·80	296·03	774 60	158·17	1,228·80	..	..	..	..
	Puvanam Parayanvayal ..	1,608·96	301·60	913·67	393·69	1,608·96	..	..	..	..
	Settivayal	101·12	55·30	..	45·82	101·12	..	..	..	..
	Ramachandrapuram	19·84	19·84	..		19 84	..	..	..	..
	Ottonkadu	1,074·18	101·83	828 53	143·82	1,074·18	..	..	..	..
	Yadavapuram	1,292·54	324·12	825·63	142·79	1,292·54	..	..	..	..
	Naduvakkurichi	166·40	60·63	81·28	24·49	166·40	..	..	..	..
	Sakkaramparai	213·12	..	213 12	..	213·12	..	..	..	..
	Seruvelukadu	663·04	125·02	429·64	108·38	663 04	..	..	..	..
	Aladikkadu	224 64	47 98	154·18	22·48	224·64	..	..	..	..
	Kattayankadu	1,099·42	213·88	644·76	240 78	1,099·42	..	..	..	..
	Total ..	19,355·66	5,652·70	9,670·64	4,032·32	19,355·66	..	..	..	..
39	Raghunathapuram inams—									
	Vattalaikadu	487·04	142·28	306·39	38·37	487·04	..	..	..	..
	Viriyankottur, Mudachikkadu, Kalanikottai.	2,552·32	567 87	1,559·46	424·99	2,552·32	..	..	..	..
	Raghunayakipuram	192·00	36·42	116·31	39·27	192·00	..	..	..	..
	Kannivayagal	511·36	73·08	371·49	66·79	511·36	..	..	..	..
	Periagathikottai, Sittattikottai, Pannioran, Tevadiyavayal.	997·76	168·29	468·24	361·23	997·76	..	..	..	..
	Kahanavasal, Sholaganavoyal.	1,559·04	285·22	996·29	277·53	1,559·04	..	..	..	..
	Korttier	293·76	204·09	8·71	80·96	293·76	..	..	..	..
	Ennattavadu	2,049·92	1,026·65	563·07	460·20	2,049·92	..	..	..	..
	Pettuvalliavayal	440·96	98·85	271·34	70·77	440·96	..	..	..	..
	Kodivayal	309·76	194·34	32·50	82·92	309·76	..	..	..	..
	Marakkayanvalasai	919·04	247·99	456·97	214·08	919·04	..	..	..	..
	Sembai	27·77	7·94	7·19	12·64	27·77	..	..	..	..
	Tirunjur	366·08	150·61	52·13	163·34	366·08	..	..	..	..
	Setubavachatram	146·56	..	60·85	85·71	146·56	..	..	..	..
	Gurukkalvayal 1st bit ..	15·48	..	15·48	..	15·48	..	..	..	..
	Gurukkalvayal 2nd bit ..	107·52	64·97	8·52	34·03	107·52	..	..	..	..
	Nayakkattuvayal	209·92	70·39	105·84	33·69	209·92	..	..	..	..
	Marugupallam	947·48	157·31	696·18	93·99	947·48	..	..	..	..
	Sellinayakipuram	34·30	..	26·46	7 84	34·30	..	..	..	..
	Periyanayakipuram	163·18	68·12	56 11	38 95	163 18	..	..	..	..
	Sendampettai	243·20	27·96	169·23	46·01	243·20	..	..	..	..
	Kuruvikkarambai, Pambattivayal, Vavelanvoyal, Kalkulam, Kanjeevakkadu, Melapungudikadu and Kallerkadu.	3,162·88	608·67	1,832·57	721·64	3,162 88	..	..	..	..
	Palacherikadu *alias* Alagianayakipuram.	539·52	192·52	234·89	112·11	539·52	..	..	..	..
	Gangadharapuram	526·08	102·63	367·70	55·75	526·08	..	..	..	..
	Kollankarambai	185·60	62·58	55·14	67·88	185·60	..	..	..	..
	Kottaikadu	170·88	20·44	101·15	49·29	170·88	..	..	..	..
	Geralivoyal	243·20	53·75	172·31	17·14	243 20	..	..	..	..
	Tulukkavoyal	200·32	21·08	108·37	70·87	200·32	..	..	..	..
	Total ..	17,602 93	4,654·05	9,220·89	3,727·99	17,602 93	..	..	..	..
	Unsettled inams									
	Valliyadikadu	10·91	5·63	4·16	1·12	10·91	..	..	..	..
	Nadiyam	1,636·04	691·51	294·81	649·72	1,636·04	..	..	..	..
	Karambaikadu	490·83	20·70	218·13	252 00	490 83	..	..	..	..
	Alamathikadu	385·72	56·65	137·12	191·95	385 72	..	..	..	..
	Thandamaraikadu	252·09	26·34	133·00	92·75	252·09	..	..	..	..
	Pugidikadu	120·27	12·71	69·98	37·58	120·27	..	..	..	..
	Pallisolanayal	718·31	253·29	186·29	278 73	718·31	..	..	..	..
	Purasurani	46·93	16 20	9 78	20·95	46·93	..	..	..	..
	Nadiyampugal	12·61	12·61	..	..	12·61	..	..	..	..

Statement D for inams (major and minor), shrotriyams, zamins, etc., Pattukkóttai taluk—*cont.*

Number of village. (1)	Name of village. (2)	Total area. (3)	Area commanded. Wet occupied. (4)	Dry occupied. (5)	Balance. (6)	Total. (7)	Area not commanded. Wet occupied. (8)	Dry occupied. (9)	Balance. (10)	Total. (11)
		ACS.	ACS.	ACS.	ACS.	ACS.				ACS.
39	Unsettled inams—*cont.*									
	Purasuram shrotriyam ..	6·95	6·95	..	..	6·95	..	..	..	..
	Alamathikadu shrotriem ..	7·93	7 93	..	..	7 93	..	..	..	..
	Palliodainayal shrotriyam ..	2·32	2·32	..	..	2 32	..	..	..	..
	Total ..	3,690·91	1,112·84	1,053·27	1,524·80	3,690·91	..	..	..	..
40	Madappulikadu inams—									
	Nelliyadikatti	1,702·40	645·43	751·56	305·41	1,702·40	..	..	..	..
	Adanar	1,130·24	476·09	223·22	430·93	1,130·24	..	..	..	..
	Ummanendal	166·40	119·90	25·09	21·41	166·40	..	..	..	..
	Nattanikottai	683·53	94·39	490·63	98 51	683·53	..	..	..	..
	Athalur	344 32	156·94	118·67	68·71	344·32	..	..	..	..
	Peravuruni	1,649·28	461·73	858·72	328·83	1,649·28	..	..	..	..
	Manadakurichi	2,003·20	390·70	1,168·11	444·39	2,003·20	..	..	..	..
	Nilakanta Pillaiyarendal ..	73·60	29·76	40·39	3·45	73·60	..	..	..	..
	Lakshminarayanapuram ..	193·92	138·72	53·60	1·60	193·92	..	..	..	..
	Ranganayakipuram	433·92	247·81	27·82	158·29	433·92	..	..	..	..
	Vengadu	2,168·32	690·60	1,238·22	239·50	2,168 32	..	..	..	..
	Sakkiyangadu						..	..	..	..
	Narakandapalli						..	..	..	..
	Sanakarai	702·72	172·57	393·09	137·06	702·72	..	..	..	..
	Andakottai	651·52	155·59	328·22	167·71	651·52	..	..	..	..
	Enadikarambai	571·52	65·31	400·27	105·94	571·52	..	..	..	..
	Panchanadipuram	499·20	58 96	368·79	71·45	499 20	..	..	..	..
	Punaikuttikadu	161·92	46 10	114·40	1·51	161·92	..	..	..	..
	Ragunadapuram	401·28	160·00	100·00	141·28	401·28	..	..	..	..
	Total ..	13,537·29	4,110·51	6,700 80	2,725·98	13,537·29	..	..	..	..
41	Pinnavasal Vadapathi—									
	Sittathikadu	1,308·16	453·72	410·85	443·59	1,308·16	..	..	..	..
42	Pinnavasal Thenpathi—									
	Padappanvayal	371·20	125·74	182·79	62·67	371·20	..	..	..	..
	Nisambur	137·60	65·02	11·27	61·31	137 60	..	..	..	..
	Sornakadu	1,128·32	351·02	576·12	201·18	1,128·32	..	..	..	..
	Pananjeri	222·72	54·15	96·55	72·02	222·72	..	..	..	..
	Valaperumankadu	608·00	.	596·86	11·14	608·00	..	..	..	..
	Total ..	2,467 84	595·93	1,463·59	408·32	2,467·84	..	..	..	..
43	Marudangudi inam—									
	Marudangudi Thenundavayal.	917·76	452·13	223·85	241·78	917·76				
	Vallavari	1,720·32	361·77	982·18	376·37	1,720·32	..	..	..	..
	Pandikudi	371·84	90·38	192·94	88·52	371·84	..	..	..	..
	Sattanendal	242·56	84·49	67 34	90·73	242·56	..	..	..	..
	Ayangudi	2,360·32	667·95	1,281·39	410·98	2,360 32	..	..	..	..
	Edavariendal	232·96	62·[illegible]1	97·59	73·16	232·96	..	..	..	..
	Vilayanathuvayal	24·22	18 07	..	6·15	24·22	..	..	..	..
	Arasarkulam, Kilpathi ..	1,745·39	196·04	1,241·95	307·40	1,745 39	..	..	..	..
	Arasarkulam, Melpathi ..	1,875·72	313·04	1,237·64	325·04	1,875·72	..	..	..	..
	Sethurayanendal	248·96	68·33	95·35	85·28	248·96	..	..	..	..
	Balakrishnapuram	337·28	164·58	90·72	81 98	337·28	..	..	..	..
	Ramasamipuram	631·68	187·43	310·37	133·88	631·88	..	..	..	..
	Periyanur shrotriem	1,258·24	210·00	200·00	..	410·00	..	..	..	848·24
	Total ..	11,967·25	2,876·42	6,021·32	2,221·27	11,119·01	..	..	..	848·24
61	Tutagudi inams—									
	Ellitalai	470·40	52·20	339·20	79·00	470·40	..	..	..	..
	Kambacheri	211·20	43·26	82·08	85 86	211·20	..	..	..	..
	Nattumangalam	1,548·80	172·00	1,234·51	142·29	1,548·80	..	..	..	..
	Maiyakkarai	338·24	135·99	69·47	132·78	338·24	..	..	..	..
	Vairandi	190·08	130·42	43·27	16·39	190·08	..	..	..	..
	Virarajanapuram	408·32	41·15	340·63	26·54	408·32	..	..	..	..
	Viswanadapuram	84·48	37·50	25·64	21·34	84·48	..	..	..	..
	Vellivayal	275 84	38·57	188·67	48·60	275·84	..	..	..	..
	Karungulikadu	427·52	153·91	140·06	133 55	427·52	..	..	..	..
	Melamangalam	575 36	255·01	122·65	197·70	575·36	..	..	..	..
	Vinnamdiendal	259·20	78·48	135·87	44·85	259·20	..	..	..	..
	Tittakudi	206·72	75·10	64·61	67·01	206·72	..	..	..	..
	Dwarakambalpuram	250·88	27·15	211·04	12·69	250·88	..	..	..	..
	Menakkadu	331·52	84·94	174·20	72·38	331·52	..	..	..	..
	Total ..	5,578·56	1,325·68	3,171·90	1,080·98	5,578·56	..	..	..	..

Statement D for inams (major and minor), shrotriyams, zamins, etc., Pattukkótai taluk—*cont.*

Number of village.	Name of village.	Total area.	Area commanded.				Area not commanded.			
			Wet occupied.	Dry occupied	Balance.	Total.	Wet occupied.	Dry occupied.	Balance.	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		ACS.	ACS.	ACS.	ACS.	ACS.				ACS.
62	Sittakanni inams, settled—									
	Pidarikadu	371·20	30·03	248·97	92·20	371·20	..	..	..	..
	Viziyapuram	535·68	107·92	352·05	74·81	535·68	..	..	..	..
	Ambapuram	295·61	69·00	176·50	50·11	295·61	..	..	..	..
	Kodivayal	1,145·60	203·92	817·13	124·55	1,145·60	..	..	..	..
	Mangalanadu	2,008 96	486·50	822·70	699·76	2,008·96	..	..	..	..
	Maravelanvayal and Korundampattu.	274·56	60·07	115·21	99·28	274·56	..	..	..	..
	Ariyamaraikadu	295·04	95·60	132·84	66·60	295·04	..	..	..	..
	Arunachellapuram	180·48	80·55	27·24	72·69	180·48	..	..	..	..
	Unsettled inams—									
	Purushottamapuram	16·64	14·64	..	2·00	16·64	..	..	..	..
	Ramanujapuram	7·81	4·81	..	3·00	7·81	..	..	..	..
	Chidambarapuram	55·82	34·29	17 17	4·36	55·82	..	..	..	..
	Thirumeninathapuram ..	38·75	19·12	17·63	2·00	38·75	..	..	..	..
	Gopalapuram	6·47	6·47	..	..	6·47	..	..	..	..
	Vasudevapuram	6·83	6·83	..	..	6·83	..	..	..	..
	Ulagambalpuram	39·58	7·51	10·12	21·95	39·58	..	..	..	..
	Total ..	5,279·03	1,227·26	2,738·46	1,313·31	5,279·03	..	..	..	..
63	Kolakkudi inams—									
	Rettavayal shrotriem	832·00	230 92	214·83	386·25	832·00	..	..	..	..
	Manakadu	1,074·56	174·76	543·46	356·34	1,074·56	..	..	..	..
	Amarasimhendrapuram ..	1,208·94	397·64	541·30	270·00	1,208·94	..	..	..	..
	Panangulam	320·64	86·63	108·63	125·38	320·64	..	..	..	..
	Pulankottai, 1st bit	67·04	32·53	34·51	..	67·04	..	..	..	..
	Pulankottai, 2nd bit	200·96	90·47	108·90	1·59	200·96	..	..	..	..
	Total ..	3,704·14	1,012·95	1,551·63	1,139·56	3,704·14	..	..	..	..
64	Perumaghalur Vadapathi—									
	Solaikadu	914·56	454·44	243·58	216·54	914·56	..	..	..	..
	Kolakkamangalam	863·98	343·04	214·57	306·37	863·98	..	..	..	..
	Pattankadu	368·00	221·67	84·46	61·87	368·00	..	..	..	..
	Total ..	2,146·54	1,019·15	542·61	584·78	2,146·54	..	..	..	..
65	Perumaghalur Tenpathi—									
	Torangudi	736·00	476·96	162·34	96·20	736·00	..	..	..	..
	Kuppatevan	1,361·52	477·68	554·37	329·47	1,361·52	..	..	..	..
	Theruvattevan	1,751·04	380·34	865·64	505·06	1,751·04	..	..	..	..
	Ariyakutti Tevan	277·76	83·80	141·41	52·55	277·76	..	..	..	..
	Total ..	4,126 32	1,418·78	1,724·26	983·28	4,126·32	..	..	..	..
66	Valayanvayal inams—									
	Kaliyanaramanathapuram ..	478·08	150·94	222·82	104·32	478·08	..	..	..	..
	Mudukadu	812·16	12·14	737·11	62·91	812·16	..	..	..	..
	Avadaiyanikottai	421·76	162·32	61·09	198·35	421·76	..	..	..	..
	Sandalanvayal	491·52	140·32	160·51	190 69	491·52	..	..	..	..
	Adaikkalatevan									
	Villunivayal									
	Ravuttanvayal	2,224·00	361·66	1,042·73	819·61	2,224·00	..	..	..	..
	Meyyanvayal									
	Madavanvayal									
	Total ..	4,427·52	827·38	2 224·26	1,375·88	4,427·52	..	..	..	..
67	Amanjakki inams—									
	Kelakkudi	293 76	144·32	91·59	57·85	293·76	..	..	..	..
	Karaivayal	223·36	102·34	50·93	70·09	223·36	..	..	..	..
	Vellattimangalam	435·84	215·14	101·20	119·50	435·84	..	..	..	..
	Kandichohankadu	313·60	93·90	86·33	133·37	313·60	..	..	..	..
	Brahmanavayal	170·88	55·81	49·08	65·99	170·88	..	..	..	..
	Adalaikal Bhairavapuram ..	440·32	173·14	123·28	143·90	440·32	..	..	..	..
	Meivayal	256·64	124·20	27·00	105·44	256·64	..	..	..	..
	Total ..	2,134·40	908·85	529·41	696·14	2,134·40	..	..	..	..
69	Thenaiyakudi inams—									
	Attani shrotriem	2,218·24	622 64	874·09	721·51	2,218·24	..	..	..	..
	Manaiyanendal	143·36	..	..	..	..	..	..	..	143·36
	Tiruvettivayal	172·80	..	..	..	..	..	..	..	172·80
	Total ..	2,534·40	622·64	874·09	721·51	2,218·24	..	..	..	316·16
73	Nemmelikadu	396·16	133·34	113·60	149·22	396·16	..	..	..	..

Statement D for inams (major and minor), shrotriyams, zamins, etc., Pattukkóttai taluk—*cont.*

Number of village. (1)	Name of village. (2)	Total area. (3)	Area commanded. Wet occupied. (4)	Dry occupied. (5)	Balance. (6)	Total. (7)	Area not commanded. Wet occupied. (8)	Dry occupied. (9)	Balance (10)	Total. (11)
		ACS	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.
60	Kummakkadu—settled inams—									
	Andorkottai	312 96	90·17	160·39	62·40	312 96	..	..	..	..
	Vairivoyal	386·53	46·96	265·47	74 10	386·53	..	..	..	..
	Melpadi	780·80	166 42	472·45	141·93	780·80	..	.	..	..
	Ratnakottai 1st bit	1,393·92	341·04	672 99	379·89	1,393·92	..	..	..	..
	Do. 2nd bit	63·36	..	25·88	37·48	63·36	..	..	..	..
	Kolappakkadu	300·16	43·27	139·94	116 95	300·16	..	..	..	..
	Kuttadivayal	574·08	146·09	251·23	176·76	574·08	..	..	..	..
	Viswanathapuram	229·76	121 01	64·77	43·98	229·76	..	..	..	..
	Unsettled inams—									
	Pillavayal	333·25	182·42	70·06	80·77	333·25	..	..	..	..
	Kuttangudi eri	476·22	110·25	302·60	63·37	476·22	..	..	..	..
	Vattinivayal	131·88	93·51	8·97	29·40	131·88	..	..	..	..
	Kovilvayal	137·84	26·56	89·97	21·31	137·84	..	..	..	..
	Total ..	5,120·76	1,367·70	2,524·72	1,228·34	5,120·76	.	.	.	..
14	Ramapuram	47·03	23 39	23·69	..	47·08	..	..	..	..
	Gopalapuram	90·12	48·19	41·93	..	90·12	..	..	..	..
	Avadainallavijayapuram ..	1,242·42	275·35	967·07	..	1,242·42	..	..	..	..
	Chidambarapuram	170·82	23 60	147·22	..	170 82	..	..	..	..
	Vallur	14·05	7·13	6·92	..	14·05	..	..	..	.
	Nallivijayapuram	81·28	33·51	47·77	..	81 28	..	..	..	..
	Total ..	1,645·77	411·17	1,234·60	..	1,645·77	..	..	..	..
	Grand total ..	164,591·67	44,735·18	84,025·78	34,666·31	163,427·27	..	..	..	1,164·0
	Chatram inams.									
198 and 200	Rajamadam 1st and 2nd bits..	530·30	188·79	103·45	238·06	520·30	..	..	..	..
199	Rajamadam shrotriem	843·58	143 70	82·70	617·18	843·58	..	..	..	..
202	Magilankottai	931·23	297·80	156·71	364·17	818·68	1·00	80·08	31·47	112·55
221	Kasangadu	962·07	278·15	466·38	217·54	962·07	..	..	..	..
168	Sengankadu	177·34	32·08	116·77	28·49	177·34	..	..	..	..
169	Velangulam	1,812·34	877·17	35·96	899·21	1,812·34	..	..	..	..
170	Vellalankadu	399·73	111·57	182 63	105·53	399·73	..	..	..	..
171	Rudrachintamani	365·69	76·51	213·60	75·58	365·69	..	..	..	..
172	Avivayal	78·60	36·50	16·91	25·19	78·60	..	..	..	..
173	Palukadu	650·18	119·48	42·19	488·51	650·18	..	..	..	..
174	Nannavayal	138·26	44·16	32·76	61·34	138·26	..	..	..	..
138	Merppanaikadu	1,873·91	276·32	1,146·26	361·15	1,783·73	..	23·04	67·14	0·18
204	Adirampattanam	2,168·04	484·48	250·54	1,402·02	2,137·04	..	25·05	5·95	31·00
208 215	Moravakkadu	5,888·12	907·12	312·88	4,668·12	5,888·12	..	..	..	..
209	Melakkadu	1,575·16	814 11	168·05	593·00	1,575·16	..	..	..	..
210	Vadakadu	3,183·31	765·54	174·59	2,243·18	3,183·31	..	..	..	..
211	Pudukottagam	1,600·47	1,411·99		88·48	1,500·47	..	..	..	..
214	Sundiram	487·05	189·77	175·02	122·26	487 05	..	..	..	..
223	Pudukottagam Ullur	1,316·27	349·29	379·29	483 58	1,212·16	2·40	65·52	36·19	104·11
224	Kuttadivayal	463 79	261·65	5 06	197·08	463 79	..	..	..	..
255	Pannavayal	2,145·42	1,346·20	28·37	775·85	2,145 42	..	..	..	..
231	Kurichchi	1,633·61	774·19	154·83	704·59	1,633·61	..	.		..
255	Vadaseri	2,940·23	661·46	1,951 62	327·15	2,940,23	..	..	..	..
135	Turaikkadu	8,794·96	182·89	117·92	6,503·48	6,804·29	105·44	199·55	1,685·68	1,990·67
196	Kolattur	2,740·00	450·00	1,880·00	210·00	2,540·00	..	..	..	..
201	Eriporakarai	1,340·00	..	1,190·00	150·00	1,340·00	..	..	..	..
205	Narasingapuram	140·00	..	140·00	..	140·00	..	..	..	..
206	Sundaranayakipuram	660·00	260·00	370 00	30·00	660·00	..	..	..	..
207	Tamorankottai	5,270·00	680·00	4,200·00	150·00	5,030·00	..	..	240 00	240·00
220	Mannankadu	1,470·00	340·00	820·00	100·00	1,260·00	..	..	210 00	210·00
222	Palanjur	3,200·00	420·00	2,400·00	220·00	3,040·00	..	..	160·00	160·00
213	Tokkalikadu	880·00	25·00	675 00	105·00	805 00	..	..	75·00	75·00
	Total ..	56,559·66	12,805·92	17,984·49	22,555·74	53,346·15	108·84	393·24	2,511·43	3,013·51
	Minor inams in Government villages.									
2	Kavalipatti	6·02	..	5·27	..	5·27	..	..	..	0·75
3	Kaduvettividuthi	10·50	10 50	..	..	10·50	..	..	..	..
5	Vattuvakottai	17·37	..	17·37	..	17·37	..	..	..	..
6	Unjividuthi	9·41	9·41	..	..	9 41	..	..	..	..
9	Sandanakadu	1·94	..	1·94	..	1·94	..	..	..	..
10	Veppankulam	18·26	2·06	15·35	..	17·41	..	..	..	0·85

Statement D for inams (major and minor), shrotriems, zamins, etc., Pattukkōttai taluk—*cont.*

Number.	Names of villages.	Total area.	Area commanded.				Area not commanded.			
			Wet occupied.	Dry occupied.	Balance.	Total.	Wet occupied.	Dry occupied.	Balance.	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	***Minor inams in Government villages*—cont.**	ACS.	ACS.	ACS.		ACS.				ACS.
11	Alattur	29·87	7·92	21·95	..	29·87	..	..	..	..
13	Kannukudi Melpadi	9·53	1·18	8·35	..	9·53	..	..	..	..
14	Tondirampattu	3·21	3·21	..	..	3·21	..	..	..	..
15	Avikottai	1·10	..	1·10	..	1·10	..	..	..	..
16	Olaiyakunnam	5·22	..	5·22	..	5·22	..	..	..	..
17	Kandyakurchchi	14·46	1·63	12·83	..	14·46	..	..	..	..
18	Periyakottai	11·46	0·28	11·18	..	11·46	..	..	..	..
19	Vattakudi	8·79	7·22	1 57	..	8·79	..	..	..	..
20	Muttakurichchi	4·98	..	3 40	..	3·40	..	..	..	1·58
23	Pattukkottai	366·90	..	128·54	..	128·54	..	..	..	238·36
25	Naduvikkottai	6·24	..	6·24	..	6·24	..	..	..	..
26	Neiveli Vadapadi	5·08	4 30	0·25	..	4·55	..	..	..	0·53
27	Do. Tenpadi	4·86	..	..	..	..	..	..	..	4·86
31	Neduvasal Melpadi	1·47	..	..	..	..	..	..	..	1·47
40	Madapulikadu	25·96	5·94	20·02	..	25·96	..	..	..	..
41	Pinnavasal Vadapadi	1·55	..	1·55	..	1·55	..	..	..	..
43	Marudangudi	11·53	4·23	7·30	..	11·53	..	..	..	..
61	Tittagudi	4·62	1·00	..	..	1·00	..	..	..	3·62
63	Kolakkudi	0·60	..	0·60	..	0·60	..	..	..	..
64	Perumagalur Vadapadi	13·05	..	13 05	..	13·05	..	..	..	..
69	Tenaiyakudi	0·48	..	..	..	..	..	..	..	0·48
	Avadai Nallivijiyapuram ..	60·45	25·77	34·68	..	60·45	..	..	..	..
	Total ..	654·91	84·65	317·76	..	402·41	..	..	..	252·50
	Minor inams in Chatram villages.									
198 & 200	Rajamadam 1st and 2nd bits ..	10·11	4·36	5·75	..	10·11	..	..	..	..
199	Do. shrotriem ..	13·22	4 39	8·83	..	13·22	..	..	..	..
202	Magilankottai	24·30	7 35	16·95	..	24·30	..	..	..	..
221	Kasankadu	2·35	..	2·35	..	2·35	..	..	..	..
188	Meppanakkadu	14·96	6·78	8·18	..	14·96	..	..	..	..
204	Adirampatnam	129·80	17·93	111·87	..	129·80	..	..	..	..
208 & 215	Maravakkadu	66·92	50·74	16·18	..	66·92	..	..	..	..
209	Melakkadu	32·58	17·97	14·61	..	32·58	..	..	..	..
210	Vadakadu	91·83	4·70	87·13	..	91·83	..	..	..	..
223	Pudukottagam	13·82	11·48	2·34	..	13·82	..	..	..	..
231	Kurichchi	22·93	22·93	..	..	22·93	..	..	..	..
255	Vadaseri	62·06	11·55	50·51	..	62·06	..	..	..	..
	Total ..	484·88	160·18	324·70	..	484·88	..	..	..	..

ENCLOSURE S to Pattukkottai D register—Zamin areas.

Number as shown in the Taluk map.	Name of zamin.	Minor village or hamlet included.	Total area as taken out from 2″ map.	Area not commanded.	Area commanded.			
					Wet.	Tank-bed.	River.	Net dry area.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			ACS.	ACS.	ACS.	ACS.	ACS.	ACS.
164	Edaiyankottai	....	330	20	155	95	..	60
165	Manakkudi	Sinna Mangalam Panavoyal.	1,380	..	440	220	..	720
166	Nakkudi	....	145	..	..	35	..	110
189	Vembankudi	....	650	..	..	..	..	650
192	Avanam	....	1,030	290	210	130	..	400
194	Anaivayal 1st bit	....	350	350	..	..	..	..
195	Do. 2nd bit	....	95	95	..	..	..	..
167	Eganiperumanur	Subramaniyapuram and Kukur.	4,250	..	2,010	640	..	1,600
243	Vedanayakipuram	....	600	..	160	90	..	350
244	Chidambarapuram	Kilakota, Kila Mangalam, Sengalvodi and Terkukota.	11,500	1,380	1,350	700	..	8,070
251	Avadinalla Vijayapuram.	....	1,480	380	240	..	..	860
252	Alattankudikadu	Nemali and Vellur.	2,700	400	700	130	..	1,470
175	Rettavayal	....	385	..	100	..	25	260
176	Do.	....	160	..	..	40	..	120
177	Virakkudi	....	730	..	240	130	..	360
190	Seriyalur	....	1,020	..	50	110	20	840
193	Neduvasal Karambakudi	....	230	..	80	20	..	130
226	Kattaiyankadu	....	180	..	50	..	..	130
227	Ambalasamudram	....	1,060	..	150	120	80	710
234	Krishnapuram	....	100	..	10	10	..	80
240	Veppankadu	....	390	..	..	..	..	390
241	Karambayam	....	1,500	500	250	..	..	750
245	Akkaraivattam	....	1,150	..	40	180	..	930
246	Sinna Ammankudi	....	1,020	..	30	70	..	920
247	Arumangudi	....	260	..	..	..	..	260
256	Sinniyavuduthi	....	1,100	..	405	115	..	580
257	Akkaraivattam Ulkkadai.	....	8	..	..	..	..	8
217	Palayi Agraharam	....	230	..	25	..	..	205
218	Serumelakudi	....	910	..	..	410	..	500
219	Raghuramasamudram	....	315	..	290	25	..	..
242	Ambalapattu	....	4,875	1,200	850	400	..	2,425
253	Madukkur	Neduvigantangi, Vadikadu and Vikraman.	6,950	890	1,640	200	..	4,220
178	Mattur	....	410	..	142	76	..	192
228	Madanathur	....	480	..	..	25	30	425
248	Eluppaviduthi	....	265	..	30	5	..	280
249	Sillattur	....	4,540	110	860	310	120	3,140
187	Sendangudi	....	14,500	12,350	630	90	40	1,390
191	Ammaiyandi	....	670	..	180	165	..	325
232	Puvalur	Puvalur, Chinnakottakkadu, Edayankadu, Kotakadu, Tippanviduthi or Venkarai.	6,100	..	1,100	530	90	4,380
235	Kayavur	....	1,680	..	380	240	..	1,060
237	Adamba	....	2,800	420	210	420	..	1,750
216	Vavajikottai	....	620	..	240	10	..	370
18	Kalichobankota (S.)	Baloji Raghunathapuram (S.) A.P.	245	..	40	25	..	180
254	Attivetti	....	3,650	450	610	110	..	2,480
229	Ponavasal Zamin	....	2,520	150	800	160	60	1,350
230	Palattali	....	450	..	250	75	..	125
233	Vattathikkotta Kalligudi.	....	1,280	..	450	170	70	590
236	Alivalam	....	950	120	380	60	..	390
238	Kollukkadu Unjividuthi.	....	4,000	..	2,880	300	..	820
239	Enadi	....	1,500	..	315	85	..	1,100
		Total ..	93,743	19,105	18,972	6,726	535	48,405

STATEMENT D[1] for inams in the commanded villages of the Alangudi taluk—Pudukkōttai State.

Nunmber.	Name of village.	Total area.	Area commanded.				Area not commanded.			
			Wet occupied.	Dry occupied.	Balance.	Total.	Wet occupied.	Dry occupied	Balance.	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.
78	Mangadu	16·62	..	..	..	..	16·62	..	..	16·62
84	Keelatteru	10·26	10·26	..	..	10·26	..	..	..	..
85-A.	Kurumbivayal	15·98	1·90	14·08	..	15·98	..	..	..	..
85-B	Ichchamviduthi ..	..	..	..	..	..	..	..	..	..
85-C.	Tirumananjeri	44·97	21·40	1·90	..	23·30	18·23	3·44	..	21·67
85-D.	Pattattikkadu	..	..	..	..	..	..	..	..	..
90	Raghunathapuram ..	17·36	7·72	1·70	..	9·42	7·94	..	..	7·94
91	Tattamanaipatti ..	..	..	..	..	..	..	..	..	..
92	Kirattur	4·95	3·94	1·01	..	4·95	..	..	..	..
93	Pappapatti	316·11	7·81	48·47	..	56·28	39·65	208·61	11·57	259·83
94	Puduvidudi	154·23	..	..	..	..	26·80	127·43	..	154·23
95	Kilangadu	60·93	35·11	15·61	..	50·72	..	10·21	..	10·21
96	Mudalipatti	..	..	..	..	..	..	..	..	..
97	Kallumadai	98·68	25·10	68·79	..	98·68	..	..	..	..
98	Sengamedu	220·00	11·52	208·48	4·79	220·00	..	..	..	..
98-A.	Tiruppukkovil	..	..	..	..	..	..	..	..	..
99	Adappaviduthi	59·91	8·55	51·36	..	59·91	..	..	..	..
100	Peyadipatti	70·88	..	..	..	..	46·55	24·33	..	70·88
102	Sinnan Kanviduthi ..	..	..	..	..	..	..	..	..	..
103	Karambaviduthi ..	..	..	..	..	..	..	..	..	..
106	Karambakkudi	59·86	..	..	..	..	45·77	14·09	..	59·86
108	Tittanviduthi	6·66	..	..	..	..	6·66	..	..	6·66
109	Kolundaranpatti ..	100·36	25·18	63·15	..	88·33	..	12·03	..	12·03
110	Rangiyanviduthi ..	..	..	..	..	..	..	..	..	..
111	Kattatti	..	..	..	..	..	..	..	..	..
112	Kaliyaranviduthi ..	..	..	..	..	..	..	..	..	..
	Total ..	1,257 76	158·49	474·55	4·79	637·83	208·22	400·14	11·57	619·93

Taluk.	First crop or second crop.	Whether Government, inam (entire or minor), or zamindari.	Irrigable		
			Wet.		
			Class—deltaic or non-deltaic.	Occupied.	Unoccupied.
(1)	(2)	(3)	(4)	(5)	(6)
				ACS.	ACS.
Tanjore	First crop ..	Government	III, N. D. ..	1,619·62	....
			IV	4,640·97	....
			V	1,644·25	....
			III, N. D. ..	....	89·61
			IV	....	716·42
			V	....	115·74
		Minor inam (Register D)	....	47·00	....
				....	....
				1,663·00	....
		Entire inam	....	Say 1,200·00	....
				....	
		Zamin Enclosure S. ..	....	....	....
		Total inam and zamin ..	....	....	....
	Second crop.	Government	....	4,000 00	....
			....	....	....
		Inam	....	....	....
Mannargudi	First crop ..	Government	III, D. ..	2,269·97	....
			III, N. D. ..	689·33	....
			IV	964·83	....
			V	278·96	....
			III, D. ..	....	149·70
			III, N. D. ..	....	27·28
			IV	....	29·77
			V	.. .	7·68

E.

area.

Dry.			Area in columns 5, 6, 8 or 9 brought forward.	Rate.	Revenue.	Remarks.
Group.	Occupied.	Unoccupied.				
(7)	(8)	(9)	(10)	(11)	(12)	(13)
	ACS.	ACS.	ACS.	RS. A. P.	RS.	
..	....	....	1,619·62	1 10 0	Say 2,600	
..	....	....	4,640·97	2 0 0	,, 9,280	
..	....	....	1,644·25	2 14 0	,, 4,730	
	Total occupied wet ..		7,904·84	..	16,610	
..	....	....	89·61	5 0 0	Say 450	
..	....	....	716·42	5 0 0	,, 3,580	
..	....	....	115·74	5 8 0	,, 633	
	Total unoccupied wet ..		921·77	..	4,663	
I ..	8,181·00 Less 2,558·00 (Register C).					
	Say 5,600·00	....	5,600·00	5 0 0	28,000	
II ..	36,173·00 Less 3,800·00 (Register C).					
	Say 32,000·00	....	32,000 00	5 2 0	1,64,000	
		Total ..	37,600·00	..	1,92,000	
I ..	....	2,057·00				
	Less grazing ground .	567·00 (Register A).				
	Net ..	1,490·00	1,490·00	6 8 0	9,685	
II ..	....	5,968·00				
	Less grazing ground ..	1,152·00 (Register A).				
	Net ..	Say 4,800·00	4,800·00	6 2 0	29,400	
		....	6,290·00	..	39,085	
	Total Government area ..		52,716 61	..	2,52,358	
..	....	....	47·00	5 0 0	235	
..	742·00	....	742·00	5 0 0	3,710	
..	....	....	1,200·00	5 0 0	6,000	
..	11,657·00 Say 8,500·00	....	8,500·00	5 0 0	42,500	
..	10,645·00 Say 5,000·00	....	5,000 00	5 0 0	25,000	
..	....	....	68,205·61 or say 68,000 acres.	..	3,29,803	Total first-crop revenue.
..	....	....	4,000·00	2 8 0	Say 10,000	
..	24,000·00	....	24,000·00	3 1 0	,, 73,500	
..	....	....	2,000·00	3 0 0	,, 6,000	
	Total, second crop ..		30,000·00	..	89,500	
	Add 4 per cent of 7,200 acres unoccupied dry and unoccupied wet sold at Rs. 80 per acre, viz., 4 per cent of Rs. 5,76,000.			..	23,040	
			Grand Total ..	..	4,42,343	Of which 7,200 × 1 = Rs. 7,200 is indirect land revenue.
..	....	....	2,269·97	1 0 0	2,270	
..	....	....	689·33	1 8 0	1,035	
..	....	....	964·83	2 0 0	1,928	
..	....	....	278·96	2 8 0	695	
			4,203·09	..	5,928	
..	....	....	149·70	5 0 0	750	
..	....	....	27·28	4 12 0	128	
..	....	....	29·77	4 8 0	135	
..	....	....	7·68	4 12 0	38	
			214·43	..	1,051	

Taluk.	First crop or second crop.	Whether Government, inam (entire or minor), or zamindari.	Irrigable		
			Wet.		
			Class-deltaic or non-deltaic.	Occupied.	Unoccupied.
(1)	(2)	(3)	(4)	(5)	(6)
				ACS.	ACS.
Mannargudi—*cont.*					
	First crop ..	Minor inam (Register D). {	....	367·90	....
			....	....	....
		Whole inam (Register D). {	....	3,157·80 }	
			....	Say 3,000 }	....
	Second crop..	Government .. .. {	....	2,000	....
			....	....	....
		Inam	....	....	....
Pattukkottai taluk..	First crop ..	Government	II, N.D. ..	441·00	....
			III, D. ..	849·19	....
			III, N.D. ..	3,396 41	....
			IV ..	2,201·96	....
			V ..	2,288·92	....
			II, N.D. ..	....	12·81
			III, D. ..	....	149·33
			III, N.D. ..	....	445·28
			IV ..	....	149·35
			V ..	....	176·06

E—*cont.*

area.

Group. (7)	Dry. Occupied. (8)	Dry. Unoccupied. (9)	Area in columns 5, 6, 8 or 9 brought forward. (10)	Rate. (11)	Revenue. (12)	Remarks. (13)
	ACS.	ACS.	ACS.	RS. A. P.	RS.	
I	6,037·22 Less 4,429·00	(Register C).				
	1,608·22	....	Say 1,600·00	5 0 0	8,000	
II	24,485·24	....	24,485·24	5 2 0	1,25,485	
			26,085·24		1,33,485	
I	....	208·91 Less 208·91	(Note to Register A).			
II	....	Balance .. 5,467·30 Less 1,027·40	(Note to Register A). Say 4,440	6 2 0	27,195	
	Total Government area first crop		34,942·76			
..	....	....	367·90	5 0 0	1,835	
..	1,222·45	....	1,222·45	5 0 0	6,110	
..	.. :	....	3,000·00	5 0 0	15,000	
..	{ 10,588·04 Say 8,500·00 }	....	8,500 00	5 0 0	42,500	
		Total inam area ..	13,090·35			
	Total Government and inam ..		{ 48,033 11 Say 48,000 }		2,33,104	First crop revenue.
	....	....	2,000	2 8 0	Say 5,000	
	12,000	....	12,000	3 1 0	Say 36,750	
	....	....	1,000	3 0 0	3,000	
..						
..						
..						
	Total second crop area ..		15,000		44,750	
	4 per cent of unoccupied wet (214·43) and unoccupied dry (2,440) sold at Rs. 70 per acre.				13,028	
			Grand total revenue ..		2,90,882	Of which 4,654 × 1 = Rs. 4,654 is indirect land revenue.
..	....	....	441·0	Say 1 0 0 not worked. Say one.	441	
..	....	....	849·19	1 0 0	Say 849	
..	....	....	3,396·41	1 8 0	Say 5,094	
.	....	....	2,201 96	2 0 0	4,402	
..	....	....	2,288·92	2 10 0	6,006	
			9,177·48	..	16,792	
..	....	....	12 81	4 0 0	Say 48	
..	....	....	149·33	4 0 0	Say 596	
..	....	....	445·28	4 8 0	Say 2,002	
..	....	....	149·35	4 8 0	670	
..	....	....	176·06	5 0 0	880	
			932·83	..	4,196	
II	23,737·64 Less 2,220·00	(Nattam Extension Register C).				
	21,517·64	....	Say 21,000·0	5 0 0	1,05,000	
II	.... Less grazing ground (note to A).	3,103·06 579·23	Say 2,500·0	5 14 0	14,684	
	Total Government area ..		33,610·31	..	1,40,672	

Return

Taluk. (1)	First crop or Second crop. (2)	Whether Government, inam (entire or minor) or zamindari. (3)	Irrigable — Wet. — Class deltaic or non-deltaic. (4)	Occupied. (5)	Unoccupied. (6)
				ACS.	
Pattukottai taluk—*cont.*	First crop ..	Minor inam in Government villages	..	84·65 say 58·00	..
		Minor inam in chattram villages.	..	160·0	..
		Whole inam and shrotriem.	..	44,735·18 say 40,000·00	..
		Chatram elaka	..	12,805·92 say 7,000·0	..
		Zamin	..	21,147·0 say 20,000·0	..
	Second crop.	Government area ..	..	..	..
		Zamin area	..	..	..

E—*cont.*

area.

Dry.			Area in cols. 5, 6, 8 or 9, brought forward.	Rate.	Revenue.	Remarks
Group.	Occupied.	Unoccupied.				
(7)	(8)	(9)	(10)	(11)	(12)	(13)
ACS.	ACS.	ACS.	ACS.	RS. A. P.	RS.	
..	..	..	58·0	5 0 0	290	
	317·76 say 283·00		283·0	5 0 0	1,415	
..	..	..	160·0	5 0 0	800	
..	324·0	..	324·0	5 0 0	1,620	
..	..	..	40,000·0	5 0 0	2,00,000	
	84,025·78 say 65,000·0	..	65,000·0	5 0 0	3,25,000	
..	..	..	7,000 0	5 0 0	35,000	
	17,984·49 say 8,000·0	..	8,000·0	5 0 0	40,000	
..	..	Swamp.	4,000·0	5 0 0	20,000	
..	..	..	20,000 0	5 0 0	1,00,000	
..	Dry and poramboke. 60,086 0 say 30,000·0		30,000·0	5 0 0	1,50,000	
	Total area inam and zamin ..		174,825·0	..	10,14,797	
	Total area Government, inam and zamin		208,435 31			
..	11,000·0	..	11,000·0	2 15 0	32,312	
..	12,000·0	..	12,000·0	3 0 0	36,000	
..	23,000·0	..	23,000·0		68,312	Total second crop revenue.
	Add 4 per cent of unoccupied wet.		932·0			
	Unoccupied dry.		2,523·0			
			3,455 acres sold at Rs. 60 per acre.		8,292	

Total revenue 10,91,401 of which 3,455 × 14 annas, viz., Rs. 3,024, is indirect land revenue.

RETURN E—Alangudi taluk—Pudukkottai State.

First crop or second crop.	Wet.		Dry.		Total.	Rate.	Revenue.
	Occupied.	Unoccupied.	Occupied.	Unoccupied.			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ACS	ACS.	ACS.	ACS.	ACS.	RS.	RS.
First crop	3,608·56	468·25	3,677·44	608·65	8,362·90 say 8,000·0	5	40,000
Inam land	158·49	..	474·55	..	633·04 say 600·0	5	3,000
Total, first crop revenue ..	..	..	..	..	..	..	43,000
Second crop	..	..	..	..	7,000·0	3	21,000
Total, first and second crop revenue	..	..	..	..	..	..	64,000

RETURN F.—Consolidated return assuming resettlement in the Tanjore district.

Source of revenue.	New area to which water is to be supplied.							
	Government.		Minor inam.		State, zamin whole inam.		Total.	
	First crop.	Second crop	First crop.	Second crop.	First crop.	Second crop.	First crop.	Second crop.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	ACS.	ACS.	ACS.		ACS.	ACS.	ACS.	ACS.
Tanjore	52,716 61	28,000 0	789·00	..	14,700·0	2,000·0	68,205·61	30,000·0
Mannargudi	34,942·76	14,000 0	1,590·35	..	11,500·0	1,000·0	48,033·11	15,000·0
Pattukkottai	33,610·31	11,000·0	825·00	..	174,000-0	12,000·0	208,435·31	23,000·0
Alangudi (Pudukottai State.)	..	..	..	..	8,600·0	7,000·0	8,600·00	7,000·0
Second crop on existing delta.	..	70,000·0	..	..	..	..	..	70,000·0
Charge on existing delta ..	..	..	..	..	..	..	..	..
Credit for remission ..	..	..	..	..	..	..	..	..
Total ..	121,269 68	123,000·0	3,204·35		208,800·0	22,000·0	333,274·03	145,000·0

Source of revenue.	New area to which water is to be supplied—*cont.*	Area at favourable rates or exempt.	Direct receipts.			Indirect receipts.		Total gross revenue.
	Aggregate new area to which water is to be supplied.		First crop.	Second crop.	Total.	Enhanced land revenue.	Sale of unoccupied land.	
	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
	ACS.		RS.	RS.	RS.	RS.	RS.	RS.
Tanjore	98,205·61	..	3,22,603	89,500	4,12,103	7,200	23,040	4,42,343
Mannargudi	63,033·11	..	2,28,450	44,750	2,73,200	4,654	13,028	2,90,882
Pattukkottai	231,435·31	..	10,11,773	68,312	10,80,085	3,024	8,292	10,91,401
Alangudi (Pudukkottai State).	15,600·00	..	43,000	21,000	64,000	..	..	64,000
Second crop on existing delta.	70,000·00	..	..	2,60,000	2,60,000	..	..	2,60,000
Charge on existing delta ..	..	..	5,60,000	..	5,60,000	..	..	5,60,000
Credit for remission ..	..	..	25,000	..	25,000	..	..	25,000
Total ..	478,274·03	..	21,90,826	4,83,562	26,74,388	14,878	44,360	27,33,626

	RS
Total revenue	27,33,626
Deduct—revenue management and collection charges at 11 per cent of col. 17 *minus* (col. 16 + credit for remissions)	2,93,062
	24,40,564
Deduct—working expenses at As. 13-6 per acre on first crop area 333,274 acres	2,81,205
Net revenue	21,59,359

RETURN G.—Statement of wet area cultivated in the Tanjore Delta taluks—Government and minor inams.

Taluks.	Fasli 1315.		Fasli 1316.		Fasli 1317.		Total.		Average.	
	First crop	Second crop.	First crop.	Second crop.	First crop.	Second crop.	First crop.	Second crop.	First crop.	Second crop.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.
Tanjore	86,080	25,621	85,712	25,995	86,250	26,017	258·042	77,633	86,014	25,878
Kumbakonam ..	116,489	16,827	117,640	15,473	117,567	15,739	351 696	48,039	117,232	16,013
Mayavaram ..	115,828	5,284	114,086	3,632	114,969	4,226	344,883	13,142	114,961	4,381
Shiyali	55,601	2,252	54,755	4,579	56,075	2,247	166,431	9,078	55,477	3,026
Nannilam	132,661	4,004	131,139	2,526	132,255	2,958	396,055	9,488	132,018	3,163
Negapatam ..	82,083	1,351	81,580	943	83,013	1,116	246,676	8,410	82,225	1,137
Tirutturaipundi ..	75,620	4,256	75,556	3,352	77·010	4,000	228,186	11,608	76,062	3,869
Mannargudi ..	90,412	4,510	90,588	3,449	90,952	3,869	271,952	11,828	90,651	3,942
Total ..	754,774	64,105	75[illegible],056	59,949	758,091	60,172	2,263,921	184,226	754,640	61.409

RETURN H.—Table of conversion rates to I class delta wet.

Wet or dry.		Class of irrigation in the case of wet and group in the case of dry.	First crop charges.			Second crop charges.			Remarks.
			Tanjore taluk.	Mannargudi taluk.	Pattukkottai taluk.	Tanjore taluk.	Mannargudi taluk.	Pattukkottai taluk.	
(1)		(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			RS. A.	RS. A.	RS. A.	RS. A.	RS. A.	RS. A.	
All present single crop.	Occupied wet ..	II. D. ..	0 14	0 10	..	3 4	2 12	..	
		III D ..	1 0	1 0	..	2 5	2 8	..	
		III N.D. ..	1 10	1 8	1 8	2 8	2 6	2 4	
		IV N.D. ..	2 0	2 0	2 0	2 8	2 4	2 4	
		V N.D. ..	2 14	2 8	2 10	2 12	2 6	2 8	
	Unoccupied wet ..	III D ..	5 10	5 0	..				
		III N.D. ..	5 0	4 12	4 8 *				* Includes land revenue (dry) second crop charge ½ first crop charge.
		IV N.D. ..	5 0	4 8	4 8	..	..	..	
		V N.D. ..	5 8	4 12	5 0				
Occupied dry		Group I ..	5 0	5 0	..	3 4	3 3	..	
		Group II ..	5 2	5 2	5 0	3 1	3 1	2 15	
Unoccupied dry ..		Group I ..	6 8	6 6	.. *				
		Group II ..	6 2	6 2	5 14	..	..	..	

Note.—D. = Deltaic.
N.D. = Non-deltaic.

RETURN J.—Tanjore Delta wet area.

Taluks.	I Class.					II Class.	
	Single crop.		Registered double crop.		Total assessment columns 3 + 5.	Single crop.	
	Extent.	Assessment.	Extent.	Assessment.		Extent.	Assessment.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ACS	RS.	ACS.	RS.	RS.	ACS.	RS.
Tanjore	55,207	4,50,273	15,568	75,010	5,25,283	9,258	64,175
Kumbakōnam	82,755	6,82,193	6,997	34,982	7,17,175	25,779	2,07,744
Māyavaram	3,820	25,911	..	..	25,911	88,870	5 61,649
Shiyali	13,547	92,846	..	..	92,846	31,349	1,81,514
Nannilam	73,720	5,76,297	..	..	5,76,297	50,887	3,21,006
Negapatam	..	..	..	..	..	58,836	3,56,447
Mannargudi	1,242	8,109	..	..	8,109	70,947	3,98,572
Tirutturaipūndi	..	..	..	..	..	23,827	1,29,831
Pattukkōttai	..	..	..	..	..	..	..
Total	229,791	18,35,629	22,565	1,09,992	19,45,621	359,753	22,20,938
Average	..	RS. A. P. 7 15 10	..	..	..	..	RS. A. P. 6 2 10

Taluks.	II Class—*cont.*			III Class.				
	Compounded double crop.		Total assessment columns 8 + 10.	Single crop.		Compounded double crop.		Total assessment columns 13 + 15.
	Extent.	Assessment.		Extent.	Assessment.	Extent.	Assessment.	
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
	ACS.	RS.	RS.	ACS.	RS.	ACS.	RS.	RS.
Tanjore	664	1,835	66,010	1,288	9,827	..	..	9,827
Kumbakōnam	..	..	2,07,744	816	6,581	..	..	6,581
Mayavaram	..	..	5,61,649	19,336	94 562	..	..	94,562
Shiyoli	..	..	1,81,514	9,260	41,126	..	..	41,126
Nannilam	..	..	3,21,006	3,653	22,185	..	..	22,185
Negapatam	..	..	3,56,447	23,759	1,14,615	..	..	1,14,615
Mannargudi	154	250	3,98,822	12,389	53,536	..	..	53,536
Tirutturaipūndi	..	..	1,29,831	53,796	2,29,942	41	43	2,29,985
Pattukkōttai	..	..	..	268	1,054	..	..	1,054
Total	818	2,085	22,23,023	124,565	5,73,428	41	43	5,73,471
Average	..	..	..	..	RS. A. P. 4 9 8	..	..	..

Return K.—Area irrigated by Cauvery system.

Years.	First crop.	Second crop.
	ACS.	ACS.
1898–1899	884,869	109,249
1899–1900	859,268	94,855
1900–1901	894,414	99,175
1901–1902	894,072	100,148
1902–1903	889,519	92,837
1903–1904	885,868	90,306
1904–1905	892,923	96,303
1905–1906	897,892	95,724
1906–1907	894,245	88,861
1907–1908	900,796	93,237
Total ...	8,893,866	960,695
Average ...	889,386	96,069

Return L.—Statement showing the amount of land revenue remission granted from fasli 1309 to 1318 in the district of Tanjore.

Name of taluk.	Total for ten faslis.			
	Short crop and shavi.		Failure of crops on account of inundation.	
	First crop revenue.	Second crop revenue.	First crop revenue.	Second crop revenue.
(1)	(2)	(3)	(4)	(5)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1. Tanjore	49,582 0 0	..	1,387 0 0	..
2. Kumbakōnam	50,253 13 0	16,038 14 0	2,685 9 0	461 10 0
3. Māyavaram	8,758 6 0	..	56,544 0 0	..
4. Shiyali	5,490 3 0	..	21,692 3 0	12,107 10 0
5. Nannilam	17,633 0 0	25 0 0	166 0 0	..
6. Negapatam	20,917 14 0	96 1 0	52,490 13 0	..
7. Mannārgudi	16,116 0 0	217 0 0	336 0 0	6 0 0
8. Tiruturaipundi	19,874 0 0	..	..	..
9. Pattukkōttai	32,646 3 0	823 13 0	14 9 0	..
Total ..	2,21,271 7 0	17,200 12 0	1,35,316 2 0	12,575 4 0

Return M.—Cauvery Reservoir compensation statement.

Taluk.	Village.	Extent of occupied land, (patta) to be taken up.	Assessment on it.	Average value per acre.	Total value, approximate.	Value of houses.	Value of wells.	Value of trees.	Total columns 6—9.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		ACS.	RS. A.	RS.	RS.	RS.	RS.	RS.	RS.
Salem	Sholapadi	1,017·11	837 14	25	25,425	2,480	895	350	29,150
	Konur	443·01	402 2	30	13,290	2,560	900	20	16,770
	Pottaneri .. .. / Nallagoundampatti.	72·65	95 2	30	2,160	..	..	..	2,160
Dharmapuri	Gendenahalli ..	119·37	93 5	30	3,600	980	..	15	4,595
	Badrahalli	1,904·65	725 5	20	38,000	3,200	2,120	490	43,810
	Sholapadi	1,119·02	765 1	20	22,400	22,190	4,540	1,460	50,590
	Manjarahalli ..	45·46	46 3	30	1,350	600	..	..	1,950
	Nagamarai	1,593·67	1,088 6	20	32,000	7,515	450	5	39,970
	Jari Mankurichi ..	410·00	370 0	20	8,200	..	..	..	8,200
	Jari Bommasamudram.	320·00	126 0	20	6,400	..	..	..	6,400
Bhavani	Kaveripuram ..	820·35	460 1	20	16,400	34,150	3,000	..	53,550
	Sampalli	2,512·29	1,749 9	20	50,240	24,250 (Sampalli and Mulakkadu)	3,000	..	1,10,810
	Mulakkadu	1,666·57	1,018 12	20	33,320				
	Kolattur	176·54	204 13	30	5,280	..	..	..	5,280
Temples and churches ..	....	..	..	..	..	..	..	..	46,000
North Salem Forest reserve.	....	..	..	..	..	..	..	20,000	20,000
South Salem Forest reserve.	....	..	..	..	..	..	..	5,000	5,000
Coimbatore Forest reserve.	....	..	..	..	..	..	..	3,750	3,750
Dam site with acquisitions at As. 12 per acre being all patta lands.	Surplus escape.	720·0 / 480·0	540 0 / 360 0	20	24,000	included above under Sampalli.	..	..	24,000
	Total ..	..	8,882 9	..	..	..	..	..	4,71,985
			say 8,900 0	Add 15 per cent for compulsory acquisition on all but forest.					66,480
								Total ..	5,38,465
									Say, 5½ lakhs.

RETURN N.—Statement of land to be acquired for the Main canal (from Grand Anicut).

Mileage.	Average width of land in feet.	Length in miles.	Extent in acres.	Total acres.	Remarks.
From head to Tanjore $\frac{0}{0}$ to 30	330	30	1,200	..	
Total up to Tanjore ..	..	..	..	1,200	
From Tanjore down $\frac{0}{0}$ to 3	290	3	105	..	
Do. $\frac{3}{0}$ to $\frac{9}{0}$	240	6	175	..	
Do. $\frac{9}{0}$ to $\frac{33}{6}$	212	$24\frac{3}{4}$	636	..	
Do. $\frac{33}{6}$ to $\frac{50}{4}$	126	$16\frac{3}{4}$	256	..	
Do. $\frac{50}{4}$ to $\frac{54}{4}$	100	$3\frac{1}{2}$	43	..	
Do. $\frac{54}{0}$ to $\frac{58}{0}$	66	4	32	..	End of main canal.
Total up to Narasinga Cauvery ..	..	..	..	1,247	
Branch canals and major distributaries as per return N (*a*) attached	..	..	..	2,255	
Grand total ..	..	..	..	4,702	

RETURN N (*a*)—Statement of land to be acquired for the branch canal and major distributaries (from Grand Anicut Main canal).

Mileage.		Average width in feet.	Length in miles.	Acres.	Remarks.
Main canal.	Branch canal and major distributary.				
(1)	(2)	(3)	(4)	(5)	(6)
At head of main canal near Tanjore.	$\frac{0}{0}$ to 22	90	22	240	
3/0 ..	0 to 12	195	12	234	Branch canal.
	12 to 28	100	16	194	Major distributary continued from the branch canal.
	0 to 18	100	18	217	
9/0	0 to 25	100	25	303	Pattukkōttai branch canal.
11/6	0 to 6	66	6	48	
22/6	0 to 6	50	6	36	
24/11	0 to 8	80	8	78	
26/6	0 to 6	50	6	36	
28/0	0 to 8	80	8	78	
33/6 ..	0 to 4	100	4	49	Branch canal.
	4 to 16	85	12	124	Major distributary continued from the Branch canal.
	0 to 12	85	10	103	
38/4	0 to 9	80	9	87	
43/4	0 to 5	50	5	30	
46/4	4 to 7	66	7	56	
50/4	0 to $4\frac{1}{2}$	50	$4\frac{1}{2}$	27	
54/0 ..	0 to 4	85	4	41	Branch canal.
	4 to 14	60	10	73	Major distributary continued from the branch canal.
	0 to 8	60	8	58	
58/0	0 to 11	70	11	93	
Total ..	..	..	..	2,255	

RETURN—N_1—Sketch.

RETURN O.—Cost of scheme.

Particulars.	Amount.
	RS.
A. Reservoir—	
(*a*) Works at reservoir including establishment, tools and plant.	2,27,00,000
(*b*) Land compensation for reservoir	5,50,000
B. Distributary system—	
(*c*) Channel works, page 11 of G.O. No. 461 I., dated 12th November 1909	1,00,00,000
(*d*) Establishment at 23 per cent of C.	23,00,000
(*e*) Tools and plant at $1\frac{1}{2}$ per cent	1,50,000
(*f*) Land compensation	3,78,040
C. Indirect charges—	
(*g*) Abatement of land revenue on reservoir land	2,22,500
(*h*) Do. on channel land	1,62,500
(*j*) Leave and pension allowances	8,63,800
Total ...	3,73,26,840

RETURN P.

Year.	Dates of water passing into							Remarks.
	Cauvery.				Vennar.			
	Month.	Date.	Gauge reading.		Month.	Date.	Gauge reading in rear.	
			Front.	Rear.				
1890 ..	June ..	5th	2·70	2·40	June ..	8th	2·40	
1891 ..	,, ..	4th	1·40	0·20	,, ..	4th	1·40	
1892 ..	May ..	3rd	1·10	0·50	May ..	15th	1·40	
1893 ..	,, ..	16th	3·90	1·60	,, ..	16th	3·70	
1894 ..	,, ..	16th	2·50	1·80	,, ..	29th	1·50	
1895 ..	June ..	22nd	8·10	6·70	,, ..	2nd	3·60	
1896 ..	May ..	29th	5·00	..	June ..	3rd	2·00	
1897 ..	June ..	10th	2·20	1·00	May ..	5th	4·00	
1898 ..	,, ..	2nd	3·30	0 40	,, ..	5th	3·50	
1899 ..	,, ..	18th	4·60	1·8	,, ..	16th	2 40	Delay in Cauvery was due to fitting of shutters at Cauvery-Kodamurutty regulators.
1900 ..	,, ..	19th	2·20	1·9	,, ..	31st	2 90	
1901 ..	,, ..	1st	2·10	1·10	,, ..	21st	3·90	
1902 ..	,, ..	19th	8 10	2·60	June ..	19th	8·00	
1903 ..	,, ..	12th	3·70	0·40	,, ..	12th	3·20	
1904 ..	,, ..	2nd	6·30	1·00	,, ..	2nd	3·00	
1905 ..	May ..	29th	2 90	1·80	,, ..	1st	2·40	
1906 ..	June ..	26th	2·60	1·10	,, ..	28th	4·60	
1907 ..	,, ..	10th	2·50	1·50	,, ..	18th	3·50	
1908 ..	,, ..	1st	1·90	0·95	,, ..	15th	3·40	
1909 ..	May ..	10th	4·70	4·20	May ..	10th	4·90	Owing to the unusual floods in May and owing to the repairs at the Grand Anicut, the water that was coming into the Cauvery had to be allowed into the delta.

Return Q.

Estimate of growth of irrigation and revenue receipts and charges.

RETURN Q.—Estimate of growth of Irrigation

Year. (1)		Irrigated at the end of the year. (2)	Revenue — Gross — Direct receipts. — Water-rate. (3)	Credit for remission. (4)	Extra charge on delta. (5)	Indirect — Enhanced land revenue. (6)
		ACS.	RS.	RS.	RS.	RS.
3rd year, 1914–1915.	1st crop ..	15,000 D	56,250	25,000	..	..
	2nd crop ..	..	..	..	..	..
Distributaries, major.						
4th year, 1915–1916.	1st crop ..	30,000 D	1,12,500	25,000	..	..
	2nd crop ..	..	..	..	..	..
5th year, 1916–1917.	1st crop ..	10,000 N	..	..	..	..
	2nd crop ..	45,000 D	2,16,875	25,000	..	1,000
6th year, 1917–1918.	1st crop ..	60,000 N	..	..	..	..
	2nd crop ..	10,000 N 60,000 D	.. 5,43,750	.. 25,000	.. ..	.. 4,700
7th year, 1918–1919.	1st crop ..	110,000 N	..	..	..	..
	2nd crop ..	22,000 N 70,000 D	.. 8,57,875	.. 25,000	.. ..	.. 8,400
8th year, 1919–1920.	1st crop ..	160,000 N	..	..	..	..
	2nd crop ..	34,000 N 7,0000 D	.. 11,34,500	.. 25,000	.. ..	.. 12,100
9th year, 1920–1921.	1st crop ..	210,000 N	..	..	..	..
	2nd crop ..	46,000 N 70,000 D	.. 14,11,125	.. 25,000	.. ..	.. 14,878
10th year, 1921-1922	1st crop ..	260,000 N	..	..	..	..
	2nd crop ..	58,000 N 70,000 D	.. 16,87,650	.. 25,000	.. ..	.. 14,878
Dam finished.						
11th year, 1922–1923.	1st crop ..	310,000 N	..	..	..	..
	2nd crop ..	70,000 N 70,000 D	.. 19,64,375	.. 25,000	.. ..	.. 14,878
Distributaries finished.						
12th year, 1923–1924.	1st crop ..	333,274 N	..	..	..	..
	2nd crop ..	75,000 N 70,000 D	.. 20,89,388	.. 25,000	.. 5,60,000	.. 14,878
13th year to 20th year, 1924–1932, as for 12th year, Totals ..		Do.	1,67,15,104	2,00,000	44,80,000	1,19,024
Eight times 12th year figures		..	..	..	..	..
Total ..		..	2,67,89,392	4,50,000	50,40,000	2,04,736

Note.—D=Second crop
N = New

and revenue receipts and charges.

receipts and charges.

Revenue.		Charges.			Net revenue	
receipts.						
Interest on sale of waste land.	Total columns 3—7.	Working expenses at Re. 0-13-6 per acre on first crop in column 2.	Collection and revenue charges at 11 per cent on columns 3, and 6.	Total.	Including indirect revenue.	Excluding indirect revenue.
(7)	(8)	(9)	(10)	(11)	(12)	(13)
RS.	RS.	RS.	RS.	RS.	RS.	RS.
..	81,250	..	6,182	6,182	75,068	75,068
..	..	..	..	..	..	..
..	1,37,500	..	12,364	12,364	1,25,136	1,25,136
..	..	..	..	..	..	..
5,000	2,47,875	8,438	23,958	32,396	2,15,479	2,09.479
..	..	..	..	..	..	..
16,000	5,89,450	50,628	60,324	1,10,952	4,78,498	4,57,798
..	..	..	..	..	..	..
27,000	9,18,275	92,818	95,482	1,88,300	7,29,975	6,94,575
..	..	..	..	..	..	..
38,000	12,09,600	1,35,008	1,26,126	2,61,134	9,48,466	8,98,366
..	..	..	..	..	..	..
44,360	14,95,363	1,77,198	1,56,860	3,34,058	11,61,305	11,02,067
..	..	..	..	..	..	..
44,360	17,71,888	2,19,388	1,87,253	4,06,641	13,65,247	13,06,009
..	..	..	..	..	..	..
44,360	20,48,613	2,61,578	2,17,712	4,79,290	15,69,323	15,10,085
..	..	..	..	..	..	..
44,360	27,33,626	2,81,205	2,93,062	5,74,267	21,59,359	21,00,121
3,54,880	2,18,69,008	22,49,640	23,44,496	45,94,136	1,72,74,872	1,68,00,968
..	..	..	..	..	..	..
6,18,320	3,31,02,448	34,75,901	35,23,819	69,99,720	2,61,02,728	2,52,79,672

extension in delta.

irrigation.

RETURN R.—Extract from the G Return of crops for fasli 1317.

Name of the crop. (1)	Government. (2)	Minor inam. (3)	Entire inam. (4)	Zamindaris (only estimate). (5)	Total. (6)	Remarks. (7)
	ACS.	ACS.	ACS.	ACS.	ACS.	
Staple food crops. Rice	878,688	49,559	153,012	25,798	1,107,057	
Staple food crops. Varaghu or arika (வரகு) ..	40,047	238	20,902	10,015	71,202	
Staple food crops. Ragi	25,356	1,168	9,803	2,621	38,948	
Staple food crops. Great millet கொண்டை சோளம் அல்லது காக்காசோளம்	8,861	402	4,809	1,723	15,795	Both these varieties go by the name of "Cholam" "சோளம்" locally.
Staple food crops. Maize முத்துசோளம் அல்லது மக்காசோளம்	6,103	216	1,431	461	8,211	
Groundnut	44,278	566	11,627	7,118	63,589	
Pulses	15,488	708	2,915	6,570	25,681	
Gingelly	17,329	817	4,606	1,011	23,763	

RETURN S.

Collector's opinion.	*Points for Collector's opinion.*
I think so.	(1) Whether he thinks the dates of issue of water and the periods for which water will be allowed suitable and applicable to the existing and new irrigation.
It is difficult to say. People in Pattukkottai are ignorant, population is scanty and the groundnut cultivation is undoubtedly profitable. But time will probably overcome these difficulties.	(2) Whether water for irrigation will be freely taken in the new area and whether irrigation will spread steadily there, or whether there is any reason, e.g., unsuitability of soil, sparseness of population, growth of more profitable dry crops, etc., for supposing that water will not be taken.
No.	(3) Whether he anticipates any difficulty in the levy of water-rate in zamin and shrotriem tracts in the new area due to the fact that the rent is at present payable in kind or to the difficulty of apportioning the respective liabilities of landlord and tenant.
Yes.	(4) Whether it will not be necessary in order to determine the liability of zamin and shrotriem tenants to pay Government water-rate that an accurate survey should be set afoot of the extents of existing wet lands in these estates now commanded by the scheme, and that this survey should continue for a series of years, going on from now until the scheme is realized.
It would be proper, but I don't know whether it would be legal. The best way would be, perhaps, to get an agreement out of the proprietors, before allowing them to take the water.	(5) Whether, in view of the fact that most of the existing zamin wet land is under sources which we should class as III or IV and that it will in future be irrigated under a I class source, it would be proper to impose a water-rate (calculated on some differential system) on present zamin wet lands.
Yes, but it would be much resented.	(6) Whether, in view of the fact that the irrigation of the present Delta will be steadied and under more systematic control, it would be legitimate to impose on it a small increase of assessment, say Re. 1 or ½ per acre.
I am very strongly in favour of this.	(7) Whether my intention to reserve (at first, at least) and prohibit irrigation to all existing grazing grounds, jungles and reserve forests, in order to provide as far as possible for open grazing area is approved. *Note.*—In reserving space for extension of village sites and a dry belt round them, I am following on the lines of the Government Order.
No.	(8) Whether he has any particular proposals on the subject of bridges and fords over the main channels and of communications in the new irrigated area. I am reserving practically all existing porambokes, including roads and paths.

Collector's opinion.

I am in favour of its passing through as much of the moat as possible and would strongly recommend that arrangements be made to hold up water *in the moat* all the year round.

(Intd.) J.P.B.,
Collector.
15*th April* 1910.

Points for Collector's opinion.

(9) Whether he has any proposals regarding the alignment or treatment of the canal in its passage through Tanjore town. The alignment has already been described to him.

I should gladly have his opinion also on any other points that occur to him.

9*th April* 1910.

E. H. Wallace,
Special Revenue Officer,
Cauvery Reservoir Project.

II

Endorsement by R. F. AUSTIN, Esq., Collector of Tanjore, dated the 13*th June* 1910, *Ref. on Cur. No.* 3084-*G.R.*

Submitted to the Board of Revenue.

2. As the Board has already a copy of the report and its enclosures submitted direct by the Special Officer, I solicit the favour of the return to me of the copies now submitted.

3. The report deals with all the matters required to be investigated in schemes of the kind. The comments of my predecessor are of the briefest, and I am not in a position to offer much useful criticism on the deductions made in the report.

4. It is unfortunate that area commanded should comprise so large an area of other than ayan land and that the anticipated revenue is to be derived so largely from it. The project, however, promises immense benefit to the district, being calculated to effect general improvement to the agriculture of Government lands and the benefit to zamin and inam cultivation while not detracting from that, all adds to the prosperity of the district.

5. I am unable to support the suggestions thrown out in paragraph 51 of the report. It will not, I think, be possible, to enhance the rates on existing first-class delta irrigation, or contemplate a differentiation of charges between that and the new irrigated area at least on Government lands. The anticipated regrading of delta lands from second to first and third to second class is reasonable. The first suggestion, however, has not been taken into account in the revenue estimate and so does not affect the Special Officer's figures.

6. Mr. Bedford's comments on the extension of irrigation in Pattukkottai taluk deserve attention. Credit is taken for the extension of irrigation to 21,000 acres of occupied and 2,500 acres of unoccupied Government dry, fetching at a Rs. 5 rate Rs. 1,20,000 and in zamin, etc., to 30,000 acres of occupied dry and poramboke, with Rs. 1,50,000 revenue; to 73,607 acres of unoccupied dry with Rs. 3,68,035; and to 4,000 acres of "swamp" with Rs. 20,000, a total revenue of Rs. 6,58,035 for dry, etc., lands in Government, zamin and inam in the taluk. Of this, the Rs. 20,000 for swamp is extremely doubtful, but from the other available lands the Special Officer, as is seen from statement E, has made a considerable deduction in estimating the extent which is likely to take water. It is open to some doubt whether his deduction is large enough in view of the criticisms of Mr. Bedford. Against this may be set, however, the consideration that Rs. 5 is a very low water-rate for water to be offered to zamin, etc., lands, though it may be accepted for Government lands which are compelled to take the water. I am informed by the Superintending Engineer, V Circle, that zamin ryots under the Periyar project were offering the most extravagant rates for the use of project water, and it is possible that Rs. 6 or Rs. 7 or even higher rates still might be imposed as the condition of supply of the Cauvery project water to zamin, etc., lands. In Pattukkottai taluk, for example, supply is calculated for first crop on 67,718 acres of zamin, etc., wet land, the revenue at Rs. 5 per acre working out at Rs. 3,36,090. A Rs. 6 rate would mean an increase of Rs. 67,000 and odd and a Rs. 7 rate an increase of Rs. $1\frac{1}{4}$ lakhs roundly in this taluk alone.

7. In 1899, a year which is just excluded from the Special Officer's decennial calculation for remission, there was a remission of over 4 lakhs in this district. If this year could be taken into consideration the credit for remission in statement L would be appreciably raised. I doubt the propriety, however, of assuming that the project would have been of material benefit in so extraordinary a year.

8. On the whole, the revenue calculations in the report appear to me to err if at all on the side of optimism. I offer the opinion with much diffidence, however, and see no reason to doubt that the net return will be over the prescribed minimum of 5 per cent on the expenditure.

9. I solicit the very earliest notification of the land to be acquired, in view to obviate the speculative booming of land in the meantime, and shall submit proposals shortly for the reservation from darkhast and cultivation of lands in the affected area at the disposal of Government.

III

Proceedings of the Board of Revenue (R.S., Sur., L.R. and Agri.), No. 317, dated 29th June 1910.

The Hon'ble Mr. A. E. CASTLESTUART STUART, C.S.I.

The Board begs to submit, for the orders of Government, Mr. Wallace's report on the revenue aspect of the revised Cauvery Reservoir project. The report has been carefully prepared and its contents were discussed by the Settlement Commissioner in person with Mr. Wallace on the 24th May 1910 at Tanjore and again on the 30th idem at Madras. The late Collector of Tanjore (Mr. J. P. Bedford) who was consulted by Mr. Wallace at all stages of the enquiry also expressed his concurrence with the views of the latter on the more important points which are indicated in appendix S to the report. Mr. Wallace's remarks on the financial prospects of the project are on the whole thoroughly well considered and the Board has little to add to them.

2. The project was originally designed by the Public Works Department for the new irrigation of 262,330 acres of first crop and 161,170 acres of second crop, but in its modified form it is expected by that department to irrigate a new area of 330,000 acres in the first-crop season and 75,000 acres in the second-crop season.

3. *Commanded area.*—According to the details furnished by Mr. Wallace in appendices A, A_1, D and D_1, the revised project will command an area of 542,864 acres in the taluks of Tanjore, Mannārgudi and Pattukkōttai in the Tanjore district and Alangudi in the Pudukkōttai State as shown in the statement embodied in paragraph 7 infra.

4. *Deductions from the commanded area*—(i) *Poramboke.*—From the statement just referred to, it will be seen that the extent of Government land commanded by the project is 190,264 acres. This area includes 40,320 acres of land registered as poramboke, of which 12,450 acres consist of roads, railways, rivers, channels and village-sites which cannot be irrigated; and the balance is made up of tank-beds, grazing grounds, reserved forests and miscellaneous poramboke. The Special Officer states that he was instructed to exclude all tank-beds from his estimates and that all the other kinds of poramboke are useful and should be retained as such.

(ii) *Grazing grounds.*—The extents now available for grazing within the commanded area are (1) 163·43 acres of land specially set apart for that purpose and (2) 3,699 acres of reserved forest. In view of the fact that these areas are hardly sufficient to meet even the present requirements of the villeges concerned and having regard to the remarks contained in G.O. No. 1682, Revenue, dated 24th June 1909, Mr. Wallace proposes to reserve for grazing purposes, in accordance with the scale given in paragraph 17 of the report, an additional extent of 3,535 acres of unoccupied dry comprised in the commanded area.

(iii) *Village-sites.*—Mr. Wallace further proposes to reserve, with reference to G.O. No. 2470, Revenue, dated 7th September 1909, 911 acres for extension of village-sites and 13,007 acres for the provision of a dry zone of 50 yards round villages and hamlets. The methods by which he has arrived at these figures are explained in paragraphs 18 to 25 of the report.

5. Mr. Bedford was strongly in favour of prohibiting the irrigation of all existing grazing grounds, jungles and reserved forests, but Mr. Austin expresses his inability to offer much useful criticism on the deductions proposed by Mr. Wallace. The Board is inclined to think that Mr. Wallace's proposals are on the whole reasonable and that the extents specified by him may with advantage be excluded from irrigation.

6. *Irrigable areas.*—After making the deductions detailed above the Special Officer estimates the area likely to be newly irrigated under the project at 333,274 acres in the first-crop season and 75,000 acres in the second-crop season. As a result of his investigations in 1905 Mr. Wallace had found that the second-crop irrigation in the Tanjore delta could be extended by 70,000 acres on the completion of the project. He is of opinion that the revised project also can be relied on to bring about the same extension of second-crop cultivation. The total area of second crop irrigation expected under the project is thus 145,000 acres. Having regard to the fact that Mr. Wallace had the opportunity in 1905 and again in 1910 of carefully considering the circumstances of each tract, the Board is of opinion that his estimates of irrigable areas may be accepted.

7. The subjoined table gives details of the commanded and irrigable areas in each taluk :—

—		Tanjore.	Pattukkottai.	Mannargudi.	Alangudi.	Total.
		ACS	ACS.	ACS.	ACS.	ACS.
Government ..	Commanded area ..	82,530	47,746	59,988	..	190,264
	Irrigable area ..	52,717	33,610	34,943	..	121,270
Zamindari ..	Commanded area ..	11,345	74,638	..	..	85,983
	Irrigable area ..	5,000	50,000	..	..	55,000
Inam	Commanded area ..	17,838	217,661	16,741	..	252,240
	Irrigable area ..	10,489	124,825	13,090	..	148,404
Pudukkottai State.	Commanded area ..	..	..	..	14,377	14,377
	Irrigable area ..	..	..	..	8,600	8,600
Total ..	Commanded area ..	111,713	340,045	76,729	14,377	542,864
	Irrigable area ..	68,206	208,435	48,033	8,600	333,274

8. *Revenue receipts.*—(i) In preparing the revenue forecast of the revised project Mr. Wallace has rightly proceeded on the assumption that the resettlement of the Tanjore district which is due in 1923–1924 will be carried out immediately on the completion of the project and that the entire extent of Government land irrigable by it will, at resettlement, be transferred to wet and assessed at first-class delta rates. A table showing the increase of revenue per acre in respect of the various classes of irrigable lands after their conversion to wet is given in appendix H to the report; and the revenue receipts have been worked out on the basis of the rates given therein.

(ii) *Receipts from Government lands.*—The irrigable area of Government lands is made up of 21,286 acres of occupied wet, 2,069 acres of unoccupied wet, 84,685 acres of occupied dry and 13,230 acres of unoccupied dry. Mr. Wallace expects that 53,000 acres out of this area will be irrigated in the second-crop season. The application to these lands of the rates given in the table referred to above will result in an income of Rs. 7,18,251 inclusive of a sum of Rs. 14,878 which represents the dry assessment on unoccupied lands.

(iii) *Receipts from non-Government lands including minor inam, entire inam and zamindari lands.*—The total irrigable area under this head is estimated at 203,404 acres in the first-crop season and 15,000 acres in the second-crop season and includes 71,833 acres of wet lands. The Special Officer states that no portion of the irrigable area is entitled to water free of charge or at favourable rates and that the whole of the wet area will take project water inasmuch as its present registered sources are precarious or receive no supply until the end of October in each year. In 1905 Mr. Wallace suggested that the rate of water-cess in respect of all non-Government lands might be fixed at Rs. 5 per acre for the first crop and Rs. 3 per acre for the second crop. He proposes to apply the same rates to all non-Government lands under the revised project, although he thinks, with good reason, that Rs. 6 or Rs. 7 for the first crop and Rs. 4 for the second crop would be none too high. Mr. Austin also

observes that the rates proposed by Mr. Wallace are very low and suggests the imposition of higher rates. The Board agrees with Mr. Austin and recommends that Mr. Wallace's rates may be raised by at least a rupee each. Should this recommendation meet with the approval of Government, the revenue derivable from non-Government lands will amount to Rs. 12,80,424 against Rs. 10,62,020 estimated by the Special Officer. The Board would be prepared to recommend the adoption of even higher rates, viz., Rs. 7 for the first crop and Rs. 5 for the second crop, if necessary, to place this valuable project on an absolutely safe footing. The revenue derivable from non-Government lands would thus amount to Rs. 14,98,828 against the Special Officer's estimate of Rs. 10,62,020.

(iv) *Receipts from lands in the Pudukkottai State.*—Mr. Wallace is of opinion that 8,600 acres of land in the Pudukkottai State will be irrigated by the project and that 7,000 acres out of that area will take water for a second crop. He suggests that the irrigation of these lands should be charged at the same rates as those fixed for other non-Government lands and this suggestion is, in the Board's opinion, reasonable. If the alternative rates recommended in the preceding paragraph are approved, a sum of Rs. 79,600 or Rs. 95,200 will be realized on account of water supplied to the Pudukkottai State.

(v) *Increase of revenue consequent on the extension of second-crop cultivation in the delta.*—In 1905, Mr. Wallace estimated that an income of Rs. 2,60,000 would be derived from the irrigation of a second crop on the 70,000 acres referred to in paragraph 6 supra and he proposes to adopt the same amount in his present forecast.

(vi) *Increase of revenue due to the raising of tarams in the delta.*—In paragraph 51 of his report Mr. Wallace has raised the question whether in view of the fact that the proposed reservoir will be steady and render continuous, instead of fitful and fluctuating, the water-supply to the present delta, a small increase of assessment to represent the money value of that increased steadiness of supply should not be imposed on lands comprised in the existing delta. He gives it as his opinion that no good case can be made out for the imposition of an extra assessment on the present first-class delta lands seeing that these lands have even now a very assured supply. He, however, considers that in view of the better supply afforded by the project all the existing second and third class lands in the delta can, at resettlement, be raised to the first and second class, respectively, and anticipates, as a result of these alterations, an increased revenue of Rs. 5,60,000 as explained in paragraphs 55 and 56 of the report. Mr. Bedford saw no objection to the raising of the rates of assessment throughout the delta, but he feared that such a course would be strongly resented. On the other hand his successor, Mr. Austin, is opposed to the enhancement of rates on first-class delta lands, although he considers that the proposed regrading of delta lands from second to first class and from third to second class is reasonable. The Board is of opinion that the question raised by Mr. Wallace is practically that of enhancing delta rates at resettlement and that properly speaking this is a matter which should be considered and decided at that time with reference to the economic conditions of the district. Whatever may be the decision that may eventually be arrived at the Board considers that it would at all events be perfectly safe to assume for the purpose of the present forecast that the first-class delta rates will certainly not be reduced, but that the tarams of the existing second and third class lands will in all probability be raised in consequence of the improved irrigational facilities afforded by the project.

(vii) *Indirect revenue receipts—(a) Interest on sale-proceeds of watse lands.*—The sale-proceeds of (1) 7,200 acres of waste lands in the Tanjore taluk at Rs. 80 per acre, (2) 4,654 acres in the Mannārgudi taluk at Rs. 70 per acre, and (3) 3,455 acres in the Pattukkōttai taluk, at Rs. 60 per acre, will amount to Rs. 11,09,080 and 4 per cent of this sum or Rs. 44,360 will, as usual, be credited to the project.

(b) Dry assessment on unoccupied lands.—As observed in paragraph 8 (ii) supra, a sum of Rs. 14,878 is creditable to the project under this head.

9. *Gross revenue receipts.*—The total direct and indirect revenue receipts as detailed above amount to Rs. 29,42,635 or Rs. 31,76,639 if the alternative higher water-rates are adopted. To this sum Mr. Wallace proposes to add Rs. 25,000 which represents the annual savings in remissions on account of floods and shavi

which it is estimated will be effected on the completion of the reservoir; and the Board considers it reasonable that this amount should be credited as an item of receipts under the project. The gross revenue will therefore be Rs. 29,67,635 or Rs. 32,01,639, if the alternative higher water-rates are adopted.

10. *Working expenses.*—Mr. Wallace states that he was instructed by the Special Superintending Engineer to calculate charges of maintenance at 13½ annas per acre and of collection at 11 per cent of all revenue except interest on sale-proceeds of waste lands. At these rates the total deductions to be made from the gross receipts come to Rs. 6,00,010 or Rs. 6,25,750. The net revenue receipts will therefore amount to Rs. 23,67,625 or Rs. 25,75,889 according as to whichever of the alternative higher rates are adopted. The Board, however, observes that in the case of the original project collection charges were fixed at 5 per cent and that if this rate were adopted the net revenue derivable from the project would be raised to Rs. 25,41,521 or Rs. 27,63,825.

11. *Cost of the project.*—The cost of the project has been worked out by Mr. Wallace to Rs. 3,73,26,840, which includes a sum of Rs. 9·28 lakhs on account of compensation for lands required for the construction of the reservoir as well as the grand anicut channel and distributaries. Mr. Wallace states that the reservoir will submerge about 1,500 acres of reserve forest in the Coimbatore district and about 25,000 acres in the North and South Salem districts. It is reported by the District Forest Officers concerned that there is no valuable timber either on the Coimbatore side or on the South Salem side and that the scrub on these sides is valued at Rs. 5 and Rs. 7-8-0 per acre respectively. On the other hand the portion which will be submerged in the North Salem district contains valuable timber and its value has been fixed by the District Forest Officer at Rs. 30 per acre. Having regard to the facilities that the reservoir will give in future for the transport of forest timber, the District Forest Officers consider that the Public Works Department should be debited with only one-half of the estimated value of the forests and Mr. Wallace has accordingly included in the cost of the project a sum of Rs. 28,750 which represents a moiety of their value. The Board in the Land Revenue Department has considered and accepted this estimate.

12. *Return from the project.*—The net revenue of Rs. 23,67,625 arrived at in paragraph 10 supra represents a return of 6·3 per cent on the capital outlay. The return will, however, be raised to 6·8 if collection charges are calculated at 5 per cent as was previously done. If the higher water-rates suggested are approved the returns will be 6·9 or 7·4 per cent according as the collection charges are calculated at 11 per cent or 5 per cent.

13. A statement showing the growth of irrigation as well as of receipts and charges under the project is appended.

14. *Paragraph* 35 *of the report.*—After the project is sanctioned the Collector will be requested to formulate proposals for a reliable and systematic survey of occupation and cultivation in the zamindari areas commanded by the project.

15. *Paragraph* 71 *of the report and paragraph* 9 *of the Collector's endorsement.*—The Board requests that the attention of the Public Works Department may be invited to the remarks contained in paragraph 71 of Mr. Wallace's report and paragragh 9 of the Collector's endorsement regarding the acquisition of lands required for the project.

(True extract)

L. D. SWAMIKANNU,
Secretary.

To the Secretary to Government, Revenue Department.
" Land Revenue Department.

[Appendix.

Appendix.

Statement showing the growth of irrigation and revenue receipts and charges.

Year.	Irrigated area at the end of the year.	Revenue receipts and charges. — Gross revenue due to works. — Direct receipts.	Enhanced land revenue due to irrigation inclusive of savings in remission.	Total.
(1)	(2)	(3)	(4)	(5)
	ACS.	RS.	RS.	RS.
1914–1915	15,000 D ..	55,700	25,000	80,700
1915–1916	30,000 D ..	1,11,400	25,000	1,36,400
1916–1917	60,000 N ..	5,27,140	31,000	5,58,140
	45,000 D ..	5,87,140		6,18,140
1917–1918	110,000 N ..	8,82,860	45,700	9,28,560
	60,000 D ..	9,92,860		10,38,560
1918–1919	160,000 N	12,20,000	60,400	12,80,400
	70,000 D ..	13,80,000		14,40,400
1919–1920	210,000 N ..	15,20,000	75,100	15,95,100
	70,000 D ..	17,30,000		18,05,100
1920–1921	260,000 N ..	18,20,000	84,238	19,04,238
	70,000 D ..	20,80,000		21,64,238
1921–1922	310,000 N ..	21,20,000	84,238	22,04,238
	70,000 D ..	24,30,000		25,14,238
1922–1923	333,274 N ..	23,23,397	84,238	24,07,635
	70,000 D ..	25,57,401		26,41,639
1923–1924	333,274 N ..	* 28,83,397	84,238	29,67,635
	70,000 D ..	* 31,17,401		32,01,639

Year.	Irrigated area at the end of the year.	Revenue receipts and charges—*cont.* — Charges direct and indirect against revenue account. — Working expenses at 13½ annas per acre.	Charges of collection at 11 per cent of the gross receipts excluding interest on sale-proceeds and savings in remission.	Total charges.	Net revenue due to works. — Including enhanced land revenue.	Excluding enhanced land revenue.
		(6)	(7)	(8)	(9)	(10)
	ACS.	RS.	RS.	RS.	RS.	RS.
1914–1915	15,000 D ..	..	6,127	6,127	74,573	49,573
1915–1916	30,000 D ..	..	12,254	12,254	1,24,146	99,146
1916–1917	60,000 N ..	50,625	58,095	1,08,720	4,49,420	4,18,420
	45,000 D ..		64,695	1,15,320	5,02,820	4,71,820
1917–1918	110,000 N ..	92,812	97,632	1,90,444	7,38,116	6,92,416
	60,000 D ..		1,09,731	2,02,543	8,36,017	7,90,317
1918–1919	160,000 N ..	1,35,000	1,35,124	2,70,124	10,10,276	9,49,876
	70,000 D ..		1,52,724	2,87,724	11,52,676	10,92,276
1919–1920	210,000 N ..	1,77,187	1,68,531	3,45,718	12,49,382	11,74,282
	70,000 D ..		1,91,631	3,68,818	14,36,282	13,61,182
1920–1921	260,000 N ..	2,19,375	2,01,836	4,21,211	14,83,027	13,98,789
	70,000 D ..		2,30,436	4,49,811	17,14,427	16,30,189
1921–1922	310,000 N ..	2,61,562	2,34,836	4,96,398	17,07,840	16,23,602
	70,000 D ..		2,68,936	5,30,498	19,83,740	18,99,502
1922–1923	333,274 N ..	2,81,200	2,57,210	5,38,410	18,69,225	17,84,987
	70,000 D ..		2,82,950	5,64,150	20,77,489	19,93,251
1923–1924	333,274 N ..	2,81,200	3,18,810	6,00,010	23,67,625	22,83,387
	70,000 D ..		3,44,550	6,25,750	25,75,889	24,91,651

Note.—(1) N denotes new area.
(2) D denotes extension of second-crop irrigation in the existing delta.
(3) The figures entered in thick type are those arrived at on the basis of the alternative higher water-rates.
* Includes Rs. 5,60,000 referred to in paragraph 8 (vi) of the Board's Proceedings.

* * * * * *

VIII

Telegram from the Secretary to Government, Revenue Department, to the Collector of Tanjore, dated the 29th July 1910, No. 232.

Please furnish if readily available soilwar particulars of the new irrigable area under the Cauvery Reservoir Project.

IX

Letter from R. F. Austin, Esq., I.C.S., Acting Collector of Tanjore, to the Secretary to Government, Revenue Department, dated the 2nd August 1910, No. D. 498 Spl/Rev.

With reference to the telegraphic message No. 232, dated 29th July 1910, I have the honour to report that soilwar particulars are available only for the dry area irrigable under the Cauvery Reservoir Project in Tanjore and Pattukkōttai taluks.

A statement for each taluk is submitted.

Enclosures

Soilwar particulars of dry area irrigable under the proposed Grand Anicut canal, Cauvery Reservoir Project.

Pattukkottai Taluk.

Class and sort of soil with taram. (1)		Occupied. Commanded area. (2)	Occupied. Reservation for nattam extension. (3)	Unoccupied. Commanded area. (4)	Unoccupied. Reservation for grazing ground. (5)	Balance irrigable. (6)
		ACS.	ACS.	ACS.	ACS.	ACS.
7-1	6	39 72	8·0	....	....	....
7-1	7	293·27	....	0·61	....	0·61
7-2	7	111·46	....	8·11	....	8·11
7-2	8	364·30	3·50	5·70	5·63	0·07
7-3	8	371·61	....	17·70	....	17·70
7-3	9	512·79	14·0	31·35	10·01	21·34
7-4	9	213·80	....	38·01	....	38·01
7-4	10	137·02	....	172·47	76·65	95·82
7-5	10	339·92	....	16·02	....	16·02
7-5	11	226·52	....	182 35	19·02	163·33
8-1	7	419 41	....	0 24	....	0·24
8-1	8	5,712·27	158·0	34·30	9 59	24·71
8-2	8	1,000·04	....	14·27	0·65	13·62
8-2	9	7,562·07	51·0	216·82	58 15	158·07
8-3	7	·35	....	....	....	....
8-3	9	843·74	....	2·03	1·46	0·57
8-3	10	3,396·09	10·50	543·36	121·96	421·40
8-4	10	327·28	....	15·30	4 30	11·00
8-4	11	865·06	6·0	513·34	54·40	458·94
8-5	11	225·96	....	12·65	1·66	10·99
8-5	12	684·09	4·0	1,221·29	158·61	1,062·68
12-2	9	1·16	....	....	....	....
12-3	10	....	....	....	....	....
13-1	9	....	....	....	....	....
14-2	11	51·15	....	0 60	0·60	....
14-3	12	38·56	....	56·54	56·54	....
Total ..		23,737·64	255·0	3,103·06	579·23	2,523·83

Reservation for nattam and dry belt.

Please see paragraphs 18 to 24 of the Special Officer's report.

	ACS.
3 × figure in column 5 of the Register C or 3 × (396·22 or 400 acres) = ...	1,200
4 × figure in column 7 of the Register C or 4 × 255 = ...	1,020
Total ..	2,220
Total commanded area occupied is	23,737·64
Deduct area for dry belt and nattam extension	2,220·00
Balance irrigable ..	21,517·64
Or in round figures ..	21,000
Total commanded area unoccupied is	3,103·06
Deduct reservation for grazing ground (Register A)	579·23
Balance ..	2,523·83
Or in round figures ..	2,500

SOILWAR particulars of dry area irrigable under the proposed Grand Anicut canal, Cauvery Reservoir Project.

Tanjore Taluk.

Class and sort of soil with taram. (1)		Occupied. Commanded area. (2)	Occupied. Reservation for nattam extension. (3)	Unoccupied. Commanded area. (4)	Unoccupied. Reservation for grazing ground. (5)	Unoccupied. Balance irrigable. (6)
		ACS.	ACS.	ACS.	ACS.	ACS.
3·1	4	102·34	..	44·56	4·36	40·20
3·2	4	4·93	..	..	..	..
3·2	5	3·23	..	0·09	0·9	..
3·3	Special.	4·27	..	..	..	..
3·3	6	11·79	..	8·34	8·34	..
3·4	6	15·35	..	..	..	..
3·4	7	91·37	..	260·01	..	260·01
3·5	8	74·18	..	95·49	85·44	10·05
4·1	5	5 15	..	..	..	..
4·2	6	38·48	..	18·77	..	18·77
4·3	7	136·73	..	68·11	11·84	56·27
4·4	7	11·89	..	..	..	..
4·4	8	573·75	..	284·89	199·72	85·17
4·5	9	117·98	..	289·73	155·08	134·65
4·5	10	9·17	..	14·03	..	14·03
7·1	5	7·68	..	..	..	..
7·1	6	472·24	2·70	12·56	3·68	8·88
7·1	7	3,956·37	30·00	127·16	13·58	113·58
7·2	5	14·52	..	..	..	..
7·2	Special.	66	..	..	..	..
7·2	6	74·44	..	..	..	..
7·2	7	1,321·82	16·42	45·09	14·23	30·86
7·2	8	995·63	14·00	77·59	4·72	72·87
7·3	Special.	9·77	..	5·12	..	5·12
7·3	7	22·23	..	14·04	1·18	12·86
7·3	8	1,150·75	1·30	156·15	16·17	139·98
7·3	9	1,607·48	2·00	196·30	7·13	189·17
7·4	Special.	2·70	..	..	..	..
7·4	7	·12	..	0·9	..	0·9
7·4	8	18·69	..	6·17	..	6·17
7·4	9	771·81	..	278·02	1·58	276·44
7·4	10	527·02	1·00	421·68	1·32	423·36
7·5	Special.	71·36	..	..	..	..
7·5	9	10·82	..	..	..	..
7·5	10	195·27	5·00	224·26	2·31	221·95
7·5	11	302·15	..	627·89	116·65	511·24
8·1	Special.	10 01	..	..	..	..
8·1	6	274·23	..	..	..	..
8·1	7	1,068·37	6·00	18 56	11·30	7·26
8·1	8	11,381·90	126·30	400·79	52·29	348·50
8·2	7	673·95	..	17·07	..	17·07
8·2	8	1,517·15	19·00	67 79	17·95	49·84
8·2	9	9,072·27	18·20	472·68	148·69	323 99
8·3	8	20·33	..	2·07	2·07	..
8·3	9	389·06	..	116·28	24·29	91·99
8·3	10	5,369·82	8·00	701·36	136·13	565·23
8·4	10	109·73	..	67·98	11·11	56·87
8·4	11	986·01	..	646·10	239·72	406·38
8·5	11	30·16	..	1·06	..	1·06
8·5	12	718·00	..	2,235·23	428·79	1,806·44
Total ..		44,355·13	249·92	8,026·11	1,719·76	6,306·35

REMARKS.—Reservation for nattam and dry belt—
Please see paragraphs 18 to 24 of the Special Officer's report.
3 × fig. in column 5 of the C. register or 3 × 1,786 = 5,358.
4 × fig. in column 7 of register C. or 4 × 250 = 1,000 or 6,358 acres.
Total commanded occupied area is 44,355·13.
Deduct reservation for nattam and dry belt 6,358 acres.
Balance 37,997·13 acres rounded into 37,600 acres represents irrigable area occupied.
Total commanded area unoccupied is 8,026·11.
Deduct reservation for grazing ground 1,719·76.
Balance 6,306·35 or rounded into 6,290 acres.

X

Letter from Colonel W. M. ELLIS, R.E., Superintending Engineer on Special duty, to the Chief Engineer for Irrigation, dated the 30th August 1910, No. 292–I/211.

I report an error in Mr. Wallace's report on Cauvery Reservoir Project in the area of forest to be submerged.

The error is so great that it appears possible it occurred by adding a zero to a figured area by oversight.

The area of forest reported as to be submerged in Salem district was 20,000 acres North Salem, 5,000 acres South Salem. On comparing areas I found there was obviously some mistake and sent a tracing of the Salem side waterspread limits to the Collector, Salem, and that officer reports the forest areas to be submerged approximately as below :—

	ACS.
North Salem	2,500
South Salem	1,000
Total ...	3,500

The compensation for this at the approved rates will be—

	RS.
North Salem 2,500 acres at Rs. 15	37,500
South Salem 1,000 acres at Rs. 3–12–0	3,750
Total ...	41,250

I am now sending a map of the Coimbatore side submerged area to the Collector of that district with a request to inform the *forest* area submerged in case there may be a material difference in areas.

Order—No. 3347, Revenue, dated 15th October 1910.

Miscellaneous.

The papers read above deal with Mr. Wallace's report on the financial aspects of the Cauvery Reservoir Project as revised.

2. Mr. Wallace estimates the irrigable area under the project as 333,274 acres in the first crop season and 75,000 acres in the second crop season. He also estimates that the area of second crop irrigation in the Tanjore delta will be extended by 70,000 acres. In arriving at the extent of the irrigable area, Mr. Wallace has deducted 3,534 acres on account of grazing grounds and has included 660 acres of minor inam wet lands situated in Government and proprietary villages. He has also included in the irrigible area some class III delta lands which he has raised to class I.

3. While the Government are of opinion that the existing grazing grounds and reserved forests should be retained as such, they consider it is unnecessary to reserve any further area for grazing purposes, and the deduction made on this account may therefore be removed. Referring to the 660 acres of minor inam wet lands, the Government observe that, whether their existing sources of irrigation are interfered with by the project or not, the same rate of water-cess cannot be levied on them as on Government dry lands, and for the purpose of the forecast such lands may therefore be left entirely out of account. As regards the delta lands in the commanded area Mr. Wallace has excluded class II lands from the irrigable area of the project and the 2,420 acres of class III lands should similarly be excluded. The irrigable area, when revised in the light of these remarks, amounts to 333,753 acres. This extent has, however, to be reduced to 328,395 acres which is the revenue-paying area actually irrigable under the distributaries as designed by the Public Works Department.

4. Mr. Wallace estimates the receipts from Government dry lands under the differential water-rate system on the basis of the existing rates of assessment and those from non-Government lands at fixed rates of Rs. 5 per acre for first crop and Rs. 3 per acre for second crop which represent the average charge for water on Government lands.

5. As the project is expected to render the existing supply in the delta more steady and continuous, the Government agree with the Board that for the purposes of the forecast the classification of irrigation sources in the delta including the Lower Coleroon anicut system should be raised by one class and that the revenue derived by so doing should be credited to the project. Mr. Wallace's proposal to raise the 2,420 acres of class III deltaic wet land under the Vadavar extension to class I is not approved.

6. The Government consider that all waste lands in the Government villages commanded by the project should be sold and that no reservation should be made for free assignment to resident ryots. Mr. Wallace estimates the selling price of waste lands at Rs. 80 in the Tanjore taluk, Rs. 70 in the Mannargudi taluk and Rs. 60 in the Pattukkottai taluk, but, in view of the prices realized in the area under the Periyar system, the Government consider that an average price of Rs. 100 per acre may reasonably be adopted.

7. Mr. Wallace estimates the annual savings in remission at Rs. 25,000 and has taken credit for this amount. In the case of the Nagavalli project the Government of India have objected to credit being taken for savings in remission. The question is under the consideration of this Government and until the matter has been finally disposed of this item should be excluded.

8. The gross revenue calculated on the above principles and on the basis of the existing rates of assessment amounts to Rs. 27,99,088. After deducting maintenance charges at As. 13–6 per acre on the first crop area of 328,395 acres and establishment and collection charges at 11 per cent on the total revenue excluding the enhancement in the revenue from the existing delta and interest on the sale-proceeds of waste lands and collection charges at 5 per cent on the first of the two excepted items, the net revenue derived from the project amounts to Rs. 22,59,881 which represents a return of 5·87 per cent on the estimated capital outlay of Rs. 385 lakhs.

9. By the time the project is completed, the district will have come under resettlement which is due in the year 1923–24. The Government therefore consider that the forecast should be framed with reference to the rates of assessment which may be expected to be introduced at the resettlement.

10. The prices prevailing since the last settlement, excluding years of high prices, give a commutation rate of Rs. 160 for paddy, Rs. 185 for ragi, Rs. 170 for cumbu and Rs. 110 for varagu after deducting 15 per cent for merchants' profits. Allowing the same deductions as were made at the orginal settlement for vicissitudes of season and for the increase in cultivation expenses in proportion to the increase in prices since the last settlement, the rates of assessment based on the above prices work out as shown below :—

Wet scale—Delta.

Merging of soils.										Revised rates.											
										First class.				Second class.				Third class.			
I	II	III	IV	V	VII	VIII	XII	XIII	XIV	Taram.	Rate.			Taram.	Rate.			Taram.	Rate.		
											RS.	A.	P.		RS.	A.	P.		RS.	A.	P.
..	1-A	..	..	..	..	..	..	..	..	1	18	0	0	..	..			..	..		
..	1	..	..	..	..	..	..	..	..	2	15	12	0	3	13	0	0	4	11	12	0
1	2	.	..	..	..	..	..	..	..	3	13	0	0	4	11	12	0	5	10	8	0
2	3	..	1	..	..	..	..	..	..	4	11	12	0	5	10	8	0	6	9	0	0
3	4	1	2	..	1	..	..	..	..	5	10	8	0	6	9	0	0	7	7	12	0
4	5	2	3	1	2	1	1	..	..	6	9	0	0	7	7	12	0	8	7	0	0
5	..	3	4	2	3	2	2	1	..	7	7	12	0	8	7	0	0	9	6	4	0
..	..	4	5	3	4	3	3	2	1	8	7	0	0	9	6	4	0	10	5	8	0
..	..	5	..	4	5	4	..	3	2	9	6	4	0	10	5	8	0	11	4	12	0
..	..	..	..	5	..	5	..	..	3	10	5	8	0	11	4	12	0	12	4	0	0

Dry scale.

Merging of soils.										Revised rates.			
										I group.		II group.	
I	II	III	IV	V	VII	VIII	XII	XIII	XIV	Taram.	Rate.	Taram.	Rate.
											RS. A. P.		RS. A. P.
3	2	1	..	..	..	..	..	..	..	4	4 4 0	5	3 8 0
4	3	2	1	..	..	..	..	..	..	5	3 8 0	6	3 0 0
5	4	3	2	..	1	..	..	..	..	6	3 0 0	7	2 4 0
..	5	4	3	1	2	1	1	..	..	7	2 4 0	8	1 12 0
..	..	5	4	2	3	2	2	1	..	8	1 12 0	9	1 8 0
..	..	..	5	3	4	3	3	2	1	9	1 8 0	10	1 0 0
..	..	..	..	4	5	4	..	3	2	10	1 0 0	11	0 10 0
..	..	..	..	5	..	5	..	..	3	11	0 10 0	12	0 6 0

11. The revised rates of assessment give an average differential water-rate of Rs. 6–6–0 per acre for first crop and Rs. 4 for second crop, and it is accordingly proposed to adopt Rs. 6 as the charge for first crop and Rs. 4 as that for second crop in the case of non-Government lands. The net revenue derivable from the project amounts to Rs. 26,67,116 as shown below :—

Item.	Extent.	Amount.
	ACS.	RS.
Increase in revenue from first crop area and assessment on waste land in the newly-commanded area	3,28,395	19,74,658
Second crop in the newly-commanded area and extension of second crop area in the delta	1,45,000	5,80,000
Enhancement in first crop revenue due to the raising of the classification of irrigation in the delta, including the Lower Coleroon anicut system	6,81,270	5,95,204
Enhancement in second crop revenue	67,380	33,690
Interest on sale-proceeds	18,276	73,104
Total gross revenue ...		32,56,656
Deduct—		
Maintenance charges at As. 13–6 per acre on 3,28,395 acres ...		2,77,083
Collection and establishment at 11 per cent of the total revenue excluding interest on sale-proceeds and enhancement of land revenue from the existing delta and 5 per cent on the latter ...		3,12,457
Total deductions ...		5,89,540
Net revenue ...		26,67,116
Return on the capital outlay of 385 lakhs		6·93 per cent.

12. An estimate of the growth of new receipts and charges revised in accordance with the above forecast is appended to this order.

13. The Board of Revenue is requested to call on the Collector to submit without delay a notification prohibiting the assignment on darkhast of waste land in the area which will be affected by the project.

14. With reference to paragraph 19 of Mr. Wallace's report, the Government consider that a special staff should be employed at once to localize the areas required for the extension of village-site and any other communal purposes for which land may be required later, and that steps should be taken for their immediate acquisition. The Board of Revenue is requested to submit proposals accordingly. If the land so acquired is not immediately required and there is no objection to such a course, it may be leased out for cultivation on temporary pattas.

15. Orders will issue separately on the points dealt with in paragraph 35 of Mr. Wallace's report.

(True extract)

A. G. CARDEW,
Secretary to Government.

To the Board of Revenue (Land Revenue).
,, ,, (Revenue Settlement).
,, Public Works Department (Irrigation).

APPENDIX.

Year.	Irrigated area at the end of the year.	Revenue receipts and charges.							
		Gross revenue due to works.			Charges.			Net revenue due to works.	
		Direct receipts.	Enhanced land revenue due to irrigation and interest on sale-proceeds of waste lands.	Total.	Working expenses at 13½ per acre.	Collection charges at 11 per cent of the gross receipts excluding interest on sale-proceeds.	Total.	Including enhanced land revenue and interest on sale-proceeds.	Excluding enhanced land revenue and interest on sale-proceeds.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
		RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.
1918–19 ..	15,000 N_1	90,000	..	90,000	12,656	9,900	22,556	67,444	67,444
1919–20 ..	30,000 N_1	1,80,000	..	1,80,000	25,312	19,800	45,112	1,34,888	1,34,888
1920–21 ..	80,000 N_1 15,000 D_2	5,35,700	10,000	5,45,700	67,500	59,147	1,26,647	4,19,053	4,09,053
1921–22 ..	130,000 N_1 15,000 N_2 30,000 D_2	9,51,400	30,000	9,81,400	1,09,688	1,05,314	2,15,002	7,66,398	7,36,398
1922–23 ..	180,000 N_1 30,000 N_2 45,000 D_2	13,[illegible]00	50,000	14,17,100	1,51,875	1,51,481	3,03,356	11,13,744	10,63,744
1923–24 ..	230,000 N_1 45,000 N_2 60,000 D_2	24,28,8[illegible]	72,157	25,01,051	1,94,063	2,31,222	4,25,285	20,75,766	20,03,609
1924–25 ..	280,000 N_1 60,000 N_2 70,000 D_2	28,28,894	94,196	29,23,090	2,36,250	2,75,765	5,12,015	24,11,075	23,16,879
1925–26 ..	328,395 N_1 75,000 N_2 70,000 D_2	31,62,460	94,196	32,56,656	2,77,083	3,12,457	5,89,540	26,67,116	25,72,920
1926–27 ..	328,395 N_1 75,000 N_2 70,000 D_2	31,62,460	94,196	32,56,656	2,77,083	3,12,457	5,89,540	26,67,116	25,72,920

NOTE.—(1) N_1 denotes new irrigation first crop.

(2) N_2 denotes second crop in the new area.

(3) D_2 denotes extension of second-crop irrigation in the existing delta.

II

Extracts from letter Dis. No. 29, dated the 8th September 1905, from E. H. Wallace, Esq., I.C.S., Special Officer, Cauvery Project, to the Secretary to Government, Revenue Department (through the Board of Revenue, Revenue Settlement).

* * * * * *

4. *Compensation for reservoir.*—I take up first the question of the amount of compensation to be paid for the acquisition of private lands and property which the reservoir will submerge. For details of the actual area submerged, I have depended on previous statements which were compiled by the karnams and Revenue Inspectors from village plans marked with the line of the reservoir. The price to be paid for the lands, house, wells, etc., submerged, I have checked by personal enquiries and inspection within the area. My estimate is contained in statement A, and amounts to 5½ lakhs, an increase of half a lakh on the previous estimate, due partly to the omission of the original Bahavani statements to allot any compensation for wells, and partly to the fact that the original figures of Tiruchengodu and Dharmapuri taluks were reduced for no very good reason in the Collector's office.

5. No buildings of any historical or antiquarian interest will be submerged. Old mud forts exist at Kaveripuram and Sholapadi (Salem taluk), but they are of little interest. The land generally is of the poorest description of red soil, sandy and stony and assessed at 8 or 12 annas. Most of the houses are small round thatched mud buildings. A few temples and two churches will be submerged.

6. I thought it might be possible to save much payment of compensation money by providing the dispossessed ryots with waste lands under the side channels in Bhavani and Tiruchengodu taluks. But apart from the fact that the ryots as a rule prefer to remain near their present village-sites (some of them having doubts about the stability of the dam and not caring to run risks), I subsequently found that the area of waste land commanded by the channels was too insignificant to be of any help. The ryots would prefer, instead of money, land near their own villages back from the reservoir edge. I think it will not be difficult to find them such land, but I did not go further into this matter. For the revenue aspect of the project. it must be assumed that all the compensation amount of 5½ lakhs will have to be paid.

* * * * *

45. *General remarks on project as it affects Tanjore district.*—Before proceeding to consider the project as it affects the Tanjore district in detail, I have one or two general remarks to make. First, the existing Tanjore settlement took place in 1893 and the resettlement is not due until 1923. Consequently, as the reservoir, if sanctioned, should be completed by 1914, its financial results for Tanjore district must be calculated on the basis of the present settlement; that is, wet lands now fed by inferior sources of irrigation will remain classed under those sources although irrigated by project water, and existing dry lands cannot be converted into wet, but can only be charged water-rate, and then only when water is actually taken.

46. Secondly, assessed lands, wet and dry, at present unoccupied and commanded by the project will have to be classed as wet under the project, and the question arises under what class of irrigation source they should be placed. There is no doubt, I take it, that in itself the reservoir would be classed as a 1st class source. But the matter is complicated by the fact that the water supplied by it to Tanjore will be indistinguishable from the ordinary delta supply and much of the delta supply is furnished by rivers in no way affected by the reservoir. The delta area at present is classed under three classes, I, II and III, the I class area comprising all delta irrigation in Tanjore taluk, most of Kumbakonam, the west half of Nannilam and a little of Mayavaram, and the II class area comprising the rest of Kumbakonam and Nannilam, most of Mayavaram, Negapatam and Mannargudi, and the delta portion of Tirutturaippundi. That portion of the Tanjore taluk irrigated now by the Vennar is all in the 1st class, and it seems to me that all lands comparatively close to the new Vaduvar-Pattukkotai channel and to the new Kattar tank will not be in a worse position than the present Tanjore taluk lands under the Vennar. In fact, it would be easy to show that their position will be much superior, as the new channel and tank will be constructed in the most commanding positions and will be fully supplied when necessary from the reservoir. All such area I would class without hesitation in the 1st class; and all lands towards the end of the new branch channels and towards the end of the Kattar tank channels I would class in the 2nd class. I do not consider that any of the new area commanded will be so badly situated for irrigation as to justify its being included in the III class. My theoretical division of the I and II class zones would be the border of present irrigation from Saliyamangalam to Mannargudi and then the Mannargudi-Madukkur-Pattukkottai road and from Pattukkottai along the railway line to the margin of irrigation. All north and west of this boundary I should put in the 1st class and all south and east of it in the 2nd class. The map E will make this clear. The Perambur block in respect of its superior position should be classed double-crop class I. The rest would all be classed single crop. The Tirutturaippundi block till naturally be in the II class. This division may seem needlessly complicated at present when it can be applied only to the comparatively small area of unoccupied lands, and while we are bound by the present settlement classification in respect of all occupied lands. But I have made it mainly because I intend to

propose that the project water-rate of Rs. 5 an acre 1st crop and Rs. 3 an acre 2nd crop be imposed within the I class zone, while the present water-rates of Rs. 4 an acre 1st crop and Rs. 2 an acre 2nd crop may be retained in the II class zone. It has to be remembered that the bulk of the land to be brought under new irrigation is occupied dry land and quite half of that is whole inam land, and that we can get revenue from these lands only when water is actually taken. I shall show below that in respect of the Government dry lands the project water-rate in the I class zone is no higher an assessment than if the lands were classed as I class wet under the project, as one may reasonably expect them to be after resettlement. If the reasonableness of such a water-rate on Government dry lands is admitted, it follows that there is no reason in giving whole inam lands water at Re. 1 an acre cheaper than Government lands. It has to be considered also that the proper water-rates to be imposed on whole inam lands should be finally decided once for all and charged as soon as project water is first supplied to them, as it will be difficult and troublesome to raise them subsequently. The project rates proposed are, as I have already pointed out, the same as those imposed under the Periyar project and less (in the case of a 2nd crop) than those under the Godavari delta system I propose them, not merely because, as I shall show subsequently, I believe that without the imposition of such rates the project will not pay, but also because I consider them a reasonable payment for the water with which Government is going to supply the lands.

47. I cannot think that there will be any doubt that the irrigation supply which the lands in my 1st class zone will get will be at least equivalent to and probably better than present 1st class delta irrigation. Now I have prepared for the commanded villages in each taluk what I call "conversion tables" showing the percentage of existing soils, deducing therefrom the present average assessment and the assessment which would be charged if the lands were considered to be under a first and second class delta irrigation source It was clearly impossible for me to work the difference out field by field, and so I prepared these tables of average rates for the lands in the commanded villages from the settlement registers. Statements F_1, F_5 show the tables for the Perambur block, for the villages under the Vaduvar-Pattukkottai channel and Kattar tank in Tanjore, Mannargudi and Pattukkottai taluks and for the Tirutturaippundi block I have reproduced in statement G the present Tanjore district settlement rates for facility of reference, and in statement H, I present the conversion tables in a compact form. A glance at H will show that the general conversion rate throughout for day lands to class I delta is Rs. 5, and that the general second-crop charge, assuming the dry lands were raised to first class wet, would be a little over Rs. 3. Similarly the general conversion rate for dry lands to second class delta is a little over Rs. 4 and for second crop the charge is a good deal over Rs. 2. The value of delta water to the lands in the first class zone is therefore Rs 5 an acre first crop and Rs. 3 an acre second crop and to the lands in the second class zone Rs. 4 an acre first crop and Rs. 2 an acre second crop. These are the charges which similarly classed soils in the delta are now paying for water, and it seems to me only reasonable that such charges should be imposed on the new lands.

* * * * * *

86. *Extension of second-crop cultivation in the delta.*—I find it by no means easy to come to any definite conclusion on this question. A sufficient supply of water is not the only determining factor in the case. Almost if not quite as important factors are the alleged (1) scarcity of labour, (2) scarcity of manure, (3) scarcity of grazing for ploughing cattle. There is also the prevalence of the Udu crop or mixed crop, in preference to two crops, which may or may not be the effect of the above factors On all these points, I fear some detailed discussion is necessary.

87. I shall assume for the present that a sufficient supply of water is available in an average year, on 1st June, to allow 60 or 70 thousand additional acres in the delta, now growing only one crop, to grow two crops. This assumption will be found more fully treated under head E (paragraphs 114—116 infra). There being by hypothesis no anxiety as to the sufficiency of water, what probability is there of second-crop cultivation being largely extended?

88. I have visited all the delta taluks except Shiyali which is hardly concerned in this question, and have interviewed the Revenue officials and many important ryots regarding the scarcity of labour, manure and grazing ground and the prevalence of Udu cultivation, and their effect on second-crop extension. "Udu" cultivation is of course the cultivation of a mixed Kadappu and Uttadam Samba crop. The seed is mixed before sowing. The Kadappu matures in about three months and is then cut, the Ottadam crop being cropped also, but as it matures more slowly and is not in ear at the time of Kadappu cutting, it does not appear to suffer. It remains on the ground for another four months and is then harvested. Thus in seven months two harvests are obtained with one ploughing and one manuring of the field. The outturn of the Udu crop is, as one would easily conclude, not equal to that of two separate crops and is generally estimated at about 1 and $\frac{1}{3}$ of a single crop. But at present the ryot, mainly in Nannilam and Mayavaram taluks, appears to consider that the loss to him of $\frac{2}{3}$ crop is less than the cost of a separate ploughing, separate manuring and a separate second-crop assessment would be. This Udu crop is at present charged only single crop rates, though it takes water for as long as two crops (viz, seven months) and up till now, the Board of Revenue has not considered it advisable to alter the charge. It is not easy to determine how far the cultivation of this crop has been induced by the scarcity of labour and manure, but, on the whole, my enquiries go to

show that if this scarcity could be to any extent overcome, the ryot would grow two crops in preference to this mixed crop. All things being equal, it would profit him to raise the two crops and not the Udu crop.

89. These are two ways of dealing with the question, one to order that Udu should be treated as two crops and charged accordingly, which would bring in increased revenue no doubt, but would not, in present circumstances, benefit the ryot in the least and would rather cripple him; the other, to consider whether no measures could be suggested to lessen the scarcity of labour and manure and grazing land. As regards the first, I think that the imposition of a full second-crop assessment would be a hardship and not advisable, though if the Udu cultivation does actually continue and spread to any large extent, a charge of $\frac{1}{8}$ or $\frac{1}{4}$ of the single-crop assessment might be imposed. But I think it more important to increase the second-crop cultivation, if possible, and in order to meet the difficulties which the ryot alleges would make the following suggestions.

90. The scarcity of labour is, I think, real, and is due (1) to extensive emigration over seas, (2) to the fact that practically no labour is imported into Tanjore from outside districts. The general complaint of the mirasidars is that their pannayals take advances from them and then bolt over seas. No enquiries as to the character or obligations of the intending emigrant are made at the depot. The mirasidar usually can get no redress and the coolie, in his haste to reach the promised land of the recruiter, does not wait until he has worked off his advance. The mere loss of the money or grain advanced is comparatively an unimportant matter, but the result is a strained relation between mirasidar and pannayal, the former fearing to make advances lest he lose them, and the latter refusing to work without them. I think that something ought to be done to prevent the coolie so evading his lawful obligations with impunity, and to remedy this state of matters I would propose (1) that each intending emigrant inform the village munsif of his village that he intends to emigrate, (2) that the village munsif publish his name in the village for ten days, (3) and, that, in order that the emigrant may not omit to inform the village munsif and that he may not evade his lawful obligations by emigrating, no emigration agent be allowed to accept any person without a certificate from his village munsif that his name has been published for ten days in his village and that he has no outstanding obligations against him. In order to prevent the mirasidar from refusing to allow the coolie to discharge his debts with a view to retaining a hold on him and preventing him emigrate, I think it would be sufficient if the coolie could appeal to the local Sub-Magistrate, who could hear both sides and have the matter settled before him. I think that if more confidence were thus established between master and servant, the latter would be more inclined to deal honestly with his employer and that the practice of giving the pannayals bits of land for themselves to settle on, which is at present falling into desuetude, would be revived to the mutual benefit of employer and employed.

91. The mirasidars are sometimes blamed for not going outside of the district and bringing in labour, and in this particular year it strikes me as anomalous that Tanjore should be crying out for more labour, while Government is opening relief works in Chingleput to provide labour. But the real difficulty is that the mirasidar would have no hold at all over the outside coolie if he was brought in. He would certainly demand advances and would be just as likely to bolt, after receiving them, back to his village, as his more enterprising brother who chooses a safer exile over seas. If the solution of the labour difficulty in Tanjore district is to be found in recruitment of labour in other districts, I think that some legislation on the lines of the Planters Labour Acts would be necessary. The Tanjore Agricultural Association might profitably discuss ways and means and possibly a kind of labour bureau might be formed to correspond with similar associations in other districts where the supply of labour outruns the demand for it.

92. As regards the scarcity of manure, it is a general complaint, and as a rule, no lands but seed-beds, double crop and Udu lands are manured at all. Single-crop lands are rarely manured It is said by Mr. G. P. Clerk in his settlement report on this district in 1890 (paragraph 68): "It is important to bear in mind, as one of the many advantages this district has over all others, that manuring is confined chiefly to double-crop lands and even those are not manured every year and do not require it. The rich alluvial deposits alone suffice to prevent the soil in any way deteriorating." Whether this remark was justified in 1890, and was applicable to any other part of the delta than the lands in the west of it, I am sure it is not true now, in any sense, of the delta as a whole. Lands are not manured not because the river silt supplies sufficient manure, but because no manure is, in the opinion of the ryots, procurable. I have given special attention to this point and am convinced that to say of the delta as a whole, that the river silt supplies sufficient fertilizing agency, and that manure is not needed, is, now, at least, whatever may have been the condition in the past entirely incorrect. The ryot would not omit to manure all his fields if he would get manure cheaply. All the ryots I interviewed agreed on this point, and I am inclined to think that the practice of not manuring has been attributed too hastily to the presence of fertilzing silt in the river and not at all to its true cause, viz., the absence of manure. I will deal more fully with the question of silt in part F, and confine myself now to suggesting what can be done to increase the supply of manure.

93. It must be admitted that in this matter the ryot is the reverse of enterprising. Even available sources are not wholly utilized. In Mayavaram and Negapatam large amounts of town rubbish remain unsold and there is no keen competition for it. This is partly attributed

by the ryots themselves to the miscellaneous ingredients of town rubbish heaps. They say they are full of broken glass and p ts and plantain leaves and have to be sifted at much expense. There is some truth in this and municipalities might find it pay to do the sifting themselves before sale. The loose box system of collecting animal manure is, I believe, being pushed by the Government Agricultural Inspector. But the ryot believes mainly in vegetable manure, wild indigo, sun hemp, leaves of various trees, babul, etc., and, regarding these, while I admit that there is now a great scarcity of them in the delta, I think that the ryot might have shown a little more energy in looking for them elsewhere or in trying to grow them on any available ground. For instance, I am told that much wild indigo (called Kavalai in this district and Kolinjai in Salem and Coimbatore where it is largely used and highly valued), grows near the sea coast in Tanjore, and I am sure that it could be grown easily in the uplands of Tanjore and Pattukkōttai taluks and probably could be obtained in increased quantity from neighbouring jungles in Pudukkōttai and Trichinopoly. I understand that Government now allows green manure to be grown on wet land without extra charge. If the grant of loans for the digging of wells wat encouraged the ryot could easily raise a crop of green manure in the hot months from February to June. I suggest also that the existing rule regarding the growth of trees and shrubs on porambokes may be relaxed and that ryots may be allowed to grow manure plants on open porambokes free of charge or for a nominal rental. Such porambokes, e.g., branch channel banks, etc., are at present under the control of the Forest Department but its control seems limited to punishment for any unauthorized tree-cutting. So far as I am aware, it plants no trees when existing trees die, and it has no staff to look after the existing trees on such porambokes, and the temptation to the ryot to steal them is great. I think that it should be more practically recognized that such open village porambokes are not maintained for the profit of any Government Department but for the villagers themselves, and the permission to grow manu e trees on them would be highly appreciated by the ryot. The Public Works Department might also consider whether it is not worth its while to grow manure plants on main river banks and lease them out.

94. As to the scarcity of grazing ground for cattle, which renders it difficult for the ryot to maintain good and sufficient plough cattle for holding, it is of course due mainly to the ill-considered way in which most available dry land was converted into wet at the time when assessments were abnormally low and competition for land was keen. Nothing can be done to reclaim such wet land to dry again. But I think that as a general principle 10 per cent of the assessed land in every village should be kept as dry land and not converted into wet and would recommend that in the present delta villages, where the assessed dry land is now less than 10 per cent, no further conversion to wet should be allowed, and that, where it is above 10 per cent a reserve of 10 per cent should be maintained. I have already provided for this reserve in the villages to be newly taken up for irrigation. To ensure this measure being carried out I would recommend that this 10 per cent area be actually fixed and determined, and that the fields selected should be entered in a prohibitive register for each village, noting therein that these fields are not to be converted to wet. For the sake of the health and comfort of the villagers, as well as to provide for possible extension of the villages, it would be well if this 10 per cent area were selected, where possible, so as to form a belt of dry land round the main village-site.

95. I have wandered somewhat from the main question of the extension of second-crop cultivation, but I think that, if these suggestions can be carried out, and if through them, as I anticipate, the scarcity of labour, manure, and grazing ground can be to any extent overcome, we may anticipate a considerable extention of second-crop cultivation, and I shall now consider the probable extent of that extension.

96. It will be seen from statement M that the average area in Tanjore in the delta charged with one-crop assessment is about 840,000 acres. The second-crop area average five years ago was about 83,000 acres, and now the average has dropped to 76,000 acres. Of this 840,000 acres, roughly 40,000 acres is dry land irrigated, 28,000 acres is registered double-crop wet (Government and inam) and 1,000 acres is compounded double crop wet. The balance 771,000 acres is single-crop wet. The average second-crop area is as I have said, 76,000 acres. This of course includes the registered double crop and compounded double-crop area. There is no second-crop grown on the dry land. Hence the seco d-crop area on the single-crop wet lands is 76,000 — 9,000 = 47,000 acres. This is a percentage of about 6 per cent on the whole single-crop wet area in the delta. Five years ago the percentage was about 7 per cent. I do not think that this indicates any general abandonment of second-crop cultivation, though no doubt the spread of Udu cultivation is to some extent responsible. The peculiar feature of cultivation in Tanjore is that the more important crop is grown last, and the so-called second crop first, in the year, and the cultivation of a second crop depends not on a good supply of water towards the end of the season but on early freshes at the beginning. I shall treat this point more fully under head E, but at present my opinion is that a timely supply of water at the beginning of the season is necessary for and will result in a much larger area of second crop.

97. I do not myself think that we can rely on any increase of second-crop cultivation outside the taluks of Tanjore, Kumbakōnam, Nannilam and Māyavaram, or on the present 40,000 acres of occupied dry land. The second crop cultivation must be found on the single-crop wet land in these four taluks. The total single-crop wet area in these taluks is about 438,000 acres (Government and inam), Tanjore 64,000, Kumbakōnam 124,000, Nannilam

138,000 and Māyavaram 112,000. On this area, at present, about 32,000 acres are grown with second crop, viz., Tanjore 4,600, Kumbakōnam 12,600, Nannilam 6,000 and Māyavaram 8,800, the percentage being thus about 7·2 in Tanjore, 10 in Kumbakōnam, 4·3 in Nannilam and 8 in Māyavaram. The small percentage in Nannilam is largely due to the prevalence of Udu cultivation there. In irrigation facilities it is quite as favourably situated as Māyavaram.

98. The balance of single crop wet land in these four taluks, which does not at present grow a second crop, is approximately as follows :—

	ACS.
Tanjore	59,400
Kumbakōnam	111,400
Nannilam	132,000
Māyavaram	103,200
Total ...	406,000

99. It has been previously estimated that at least 50,000 acres of this area may grow a second crop if the reservoir is constructed. This estimate was first formed when it was proposed to have a reservoir of a capacity of 30,000 millions cubic feet The reservoir proposed now will have a capacity of 40,000 millions cubic feet. Two crop lands (1) must have an early supply of water, (2) ought to be manured. The first condition will, I anticipate, be easily fulfilled. The second will be, I hope, in time, overcome, and I do not think the ryot will willingly let all the spare water go to waste for want of a little energy in importing or growing manure. I do not think that it is rash to estimate that, with an early and steady supply of water for seven or eight months, 70,000 acres of land (in addition to the existing area) will grow a second crop, say, in Tanjore 15,000 acres, in Kumbakōnam 25,000, in Nannilam 20,000 and in Māyavaram 10,000. This is only three acres for every one acre of single-crop land cultivated now with a second crop in these taluks and one-sixth of the area in them which does not now grow a second crop.

100. The average single-crop assessment in Tanjore and Kumbakōnam taluks is Rs. 8 +, in Nannilam Rs. 7 + and in Māyavaram Rs. 6 +. Hence we may anticipate as the revenue from second-crop extension—

	RS.		RS.
Tanjore	15,000 × 4	=	60,000
Kumbakōnam	25,000 × 4	=	1,00,000
Nannilam	20,000 × 3–8	=	70,000
Māyavaram	10,000 × 3	=	30,000
Total ...			2,60,000

This figure is entered in General Return N.

101. I have not considered the extension of second-crop cultivation in Trichinopoly district. There is only about 24,000 acres there of single-crop wet which is not at present cultivated with two crops, and the additional area which may be so cultivated will not perhaps be very large. At all events I do not consider 70,000 acres an overestimate for second-crop cultivation through the whole delta.

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114. *Time when water is required.*—The main question to be decided is, whether it is more necessary to supplement from the reservoir the present river supply at the beginning than at the end of the cultivation season. I have made particular enquiries all over the district on this point and find throughout a general unanimity that water should be given at the beginning rather than at the end of the season. The cultivation season in Tanjore seems to hang on the north-east monsoon. When a single crop is grown it is usually a 5-6 months, Samba or Pasanam crop. Theoretically the north-east monsoon bursts on the 15th October. Now by that time the Samba crop should be at least one month old and preferably 1½ months old, as, if young, it will be damaged by the heavy rain. That is to say, it should be sown before 1st September. On the other hand it should not be sown much before the beginning of August, because then it would be ready for harvest in December, in which month north-east rains continue, and Samba should, if possible, have no irrigation and little rain for the last month of its maturity. About 15th August is then the theoretically best date for sowing of Samba crop. It may then be two months old before the north-east rains break and may be harvested in January or February. On lands on which two crops are grown, it is the ryot's endeavour to get in a short crop before the north-east rains, generally a three months' Kuruvai crop. This is usually on the ground from about 15th June to 15th September, but often later, and, while it is maturing, the Samba crop is on the seed-beds, and is transplanted almost immediately after the Kuruvai is harvested. Kuruvai should be matured and harvested before the north-east rains,

as to harvest it during rain is impossible. It follows then that the growing of two crops on a field depends not so much on the supply of water as on its early arrival. If freshes do not arrive until late in July the ryot would probably not try to get in his short crop at all before the north-east monsoon. The reservoir project is counting on much second-crop cultivation in the delta, and in the new commanded area, and, for this to be assured, it is necessary that a supply sufficient to feed the two-crop area should be every year available as near 1st June as possible. Fields require ten days' water before ploughing, and it will be the middle of June before the seed is sown and the middle of September before it is harvested. A fortnight's rest for the land will be necessary and the long Samba crop which has been one to two months on the seed-beds may be transplanted in the beginning of October and become fixed before the north-east rains. It is, of course, impossible to expect the cultivation season to be worked with automatic regularity, but the course of cultivation ought to be generally as above. This will mean that two crop lands in the delta and new irrigated area will require water from about 1st June until the end of December, and perhaps, but not likely, if cultivation is prompt, in January.

115. The average date for freshes in the Cauvery river is 18th June, and ryots do not begin to cultivate until they are assured that the fresh is steady and not a false start, and cultivation now rarely gets under way until July. If the first freshes cannot be expected before 18th June and are often much later, then if water is to be available on 1st June it will be necessary to store water in the reservoir from the previous year and not to empty it, as was previously proposed, during the hot weather. This radical change in the working of the reservoir has already, I think, been recognized by the Chief Engineer for Irrigation in his note embodied in G.O. No. 971 I., dated 2nd September 1904, and indeed became obvious as soon as the construction of the side channels was proposed. For these channels, feeding double-crop lands throughout, must have an early supply in June, and cannot wait until freshes are held up on 15th August (which was Colonel Smart's date for the first impounding of freshes). In the note above referred to the Chief Engineer thinks that sufficient water could be stored from December to June to enable the delta cultivation to begin a fortnight earlier than usual, which would be about the beginning of June. I shall assume then that water is held over from the end of one year to be available about 1st June of the next.

116. Now the total area of land in the delta expected to raise two crops is about 115,000 acres under the project (column 25, statement N + 1,140 acres of double crop in Perambur), and the existing area of about 95,000 acres (Tanjore and Trichinopoly), which now raises two crops, in all about 210,000 acres. The long (first) crop area will be 193,000 acres (column 24, statement N + 1,140 acres in Perambur), and the existing area of 885,000 acres delta irrigation (Tanjore and Trichinopoly), in all about 1,078,000 acres. As I have shown, the long crop area does not require water much before the middle of August, and I would propose that, from 1st June to 1st August, the reservoir should be worked so as to maintain on Cauvery dam sufficient water for the two crop area *only*. . . . .

*   *   *   *   *   *

120. *The silt question.*—It must be admitted that, if the reservoir is to contain water all the year round and practically never be empty, the danger of its entrapping silt is much increased. The effect on the reservoir itself will be slight. The theoretical bed of the reservoir is about fifty feet from the river-bed, at which level the side channels are placed, and water must, through the whole cultivation season, be stored above that level to keep the side channels supplied. The capacity of the reservoir will not be affected until the area between this theoretical bed level and the actual bed level (about 5,000 millions cubic feet) is silted up. Mr. Higham came to the conclusion that silting would not appreciably affect the life of the reservoir for several hundred years. But the question as to the effect on the delta of entrapping this alluvial silt in the reservoir has to be considered. I have made careful enquiries in all parts of the delta as to how far and when this alluvial silt is deposited, and the general opinion is that, while the lands just at the head of the delta get a fair amount of this silt, lands outside Tanjore and Kumbakōnam taluks get practically none. I was told by the ryots in the other taluks that a little silt may come down the river during the early freshes of the south-west monsoon, that only the lands near the head sluices get any of it and that what they get is by no means a sufficient substitute for manure. It is curious that the ryots in these taluks all asserted that they get no silt during the north-east monsoon, while Tanjore and Kumbakōnam ryots say that the silt they get in the north-east monsoon is more abundant and better than that in the south-west. I find it difficult to explain this divergence of views, and suggest that probably the ryots of the eastern taluks depend more on rain in the north-east monsoon period and probably do not take the river water largely, or not improbably they ascribe to the effect of the silt what is really due, to the fields having had five months' rest. All agree that nothing like so much silt reaches the fields now, as a decade ago, and the explanation they give for this is that the new regulators and head sluices at the anicuts and channels hold up the silt. There can be no doubt that this is the case. It follows naturally that the more the current of a stream is controlled, the more silt it will drop The days when the ryot got unlimited silt on his fields were also the days when the channel irrigation was uncontrolled and his crops were ruined by floods.

121. The local Public Works Department officials and the ryots of the western taluks agree that little valuable silt is brought down by the Cauvery, that the south-west monsoon brings comparatively little and that the valuable silt is brought down mainly by the Bhavani and Amaravati in the north-east monsoon. The Amaravati drains largely from black-cotton soil, and one would expect it to contain much valuable silt in the north-east monsoon when the fields on its banks are pounded by the heavy north-east rains. The Amaravati and Bhavani rivers are also swifter than the Cauvery, which is a sluggish stream after it leaves Mysore territory, and are likely to drop much less silt than it on the way. Bhavani silt is much valued in Satyamangalam and Erode, so much so, I am told, that cart-loads of it are brought from the channel beds and put on the fields. I could get little information regarding Amaravati silt for little of it seems to get on to the present wet lands under it owing to the small size of the channels.

122. On the whole the Cauvery silt seems to be less in quantity and less in value than Bhavani and Amaravati silt, and most of the valuable silt is received in the north-east monsoon. The reservoir as proposed will not of course interfere in any way with the Bhavani and Amaravati rivers and should be able to gather most of its supply in the south-west monsoon or towards the end of the north-east monsoon. I do not therefore consider that the entrapping of Cauvery silt will be of much loss to the delta, and, so far as it will be a loss, it must be considered to be compensated by the additional control over the river supply, the better and steadier regulation, the increased immunity from floods and the increased facility of drainage. For with regard to the last two points it is clear that a subtraction of 40,000 millions cubic feet during full monsoon rains must render the occurrence of floods in the delta much less likely, while it will enable the delta more easily to get rid of its surplus drainage water.

123. The Board of Revenue has asked me to report how far the result of my enquiries on the silt question is supported by my own observation of lands more or less differently situated with reference to their facilities for receiving silt. I should hesitate to set the conclusions of such observations against the general opinion of local officials and ryots, had they been opposed to it. But so far as I could make observations in this season of low freshes and late cultivation, I found that only fields near the head sluices seem to receive any silt, that little of the silt seems to penetrate beyond the western taluks, and that in the other taluks the silt failed to supply the place of manure or to produce appreciably better outturn in fields receiving it than in fields which did not get it.

III

Extract from the Resolution of the Board of Revenue (Revenue Settlement), Mis. No. 5935, *dated* 10*th October* 1905.

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12. *Whether the Cauvery reservoir will intercept silt to such on extent as to injure existing cultivation in the Tanjore delta.*—This question is discussed in paragraphs 120 to 123 of Mr. Wallace's report. The enquiries of the Special Officer clearly go to show that the Cauvery silt seems to be less both in quantity and in value than the Bhavani and Amaravati silt and that most of the valuable silt is received during the north-east monsoon. The proposed reservoir will not interfere with the silt brought down by the Bhavani and the Amaravati rivers and will receive most of its supply during the south-west monsoon or towards the end of the north-east monsoon The Special Officer as a result of his enquiries and personal observations has come to the conclusion that the entrapping of Cauvery silt will not be of much loss to the delta, and, so far as it may be a loss, it must be considered to be amply compensated for by the additional control over the river supply, the better and steadier regulation, the increased immunity from floods and the increased facility of drainage. In this connexion the Board submits that, in reply to paragraph 2 of G.O. No. 342, Revenue, dated 12th April 1905, it has already suggested in B.P. Mis. No. 4163, dated 24th July 1905, the abandonment of the proposal to decide the present question with reference to data arrived at by experiments and observations and has also reported in its Proceedings, No. 4314, dated 31st July 1905, the result of the reference made to the Superintending Engineer, Poona, as to the efficiency of the undersluices in the Bhatgarh dam in preventing the deposit of silt in the Bhatgarh reservoir. The Board is further of opinion that inasmuch as Government do not undertake to supply manure in solution when supplying water for purposes of irrigation, and as in fixing settlement rates ample allowances are made on account of costs of cultivation including specially the cost of manuring, it is undesirable that the manurial properties of water supplied for irrigation should be taken into consideration in connexion with project water-rates.

IV

Extract from G.O. No. 2, Revenue, dated 2nd January 1906.

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15. As regards the question of the influence which the construction of the reservoir is likely to have on the fertilizing value of the Cauvery water in the delta, the Government agree with the Board that it would not be possible to obtain any evidence of value from such experiments as might be conducted before the construction of the reservoir is begun. They also consider that the case of the Bhatgarh dam offers no true analogy. The results of Mr. Wallace's observations and enquiries bear out the opinion expressed by Sir T. Higham and Mr. Preston that too much importance has been attached in the past to the possibility that the reservoir will decrease the amount of fertilizing silt in the water supplied to the delta. While admitting that it is impossible to estimate with any approach to accuracy what the effect of the reservoir will be in this respect, the Government are clearly of opinion that the remote contingency of a slight deterioration in the quality of the wet cultivation in the delta should not be allowed to stand in the way of the execution of a project which, apart from the large extension of wet cultivation which it will bring about elsewhere, cannot fail to benefit the existing cultivation in Tanjore by ensuring an absolutely regular and certain supply of water.

APPENDIX III.

Report on the geological suitability of the proposed sites for the Cauvery river dam in Coimbatore district (with six plates).

Introduction.—At the request of the Chief Engineer for Irrigation for Madras I was deputed to report on these sites and, in company with Col. W. M. Ellis, R.E., the Superintending Engineer of the project, I arrived at Bhavani on the morning of the 10th of July.

Colonel Ellis had previously explained to me that pits had been dug along the lines of three sites, two in the village area of Sampalli and one at the hill of Urachimalai. Preliminary calculations had shown that the Urachimalai site for the same height of dam (height above surface level) would give a much larger spread of water (with a superior capacity) than the sites at Sampalli. At the same time it was recognized that the rocks obtained from the pits at Urachimalai were inferior to those from Sampalli. For the foregoing reasons the question on which my opinion was required was, "Are the geological conditions at Urachimalai such that a large dam can, with safety, be built."

The rocks which are found in this portion of the Cauvery valley are of such a type that the most suitable geological conditions for a dam are found in conjunction with the most suitable engineering conditions. Thus another question comes to the front, "which is the most suitable site from a geological point of view". Both the above questions are answered in this report.

While at Sampalli, two more sites were selected. The Sampalli sites were named the A, B, C and D sites. Mr. H. A. Moss' Seccanur site was named E, and the Urachimalai site F. They will, in the body of the report, be referred to by these letters.

General geology of the district.—The Cauvery river in its course from Kauveripuram to Bhavani flows over the "mixed gneisses" of the gneissic complex of Southern India.*

Plate I gives a general idea of the disposition of the rock in this area.

The "mixed" gneisses consist of biotite gneisses and gneissose granites. With these occur bands of hornblende schists, biotite schists, biotite-hornblende schists and, apparently as intrusions of later age, there are bosses of hornblende gneiss, garnetiferous-hornblende gneiss and amphibolite.

To the west of the river (the right bank) and stretching from the neighbourhood of Sampalli to that of Neringipet is a range of hills (portion of the Pallayam Hills) which are composed entirely of members of the "charnockite" series.†

An outlier of these charnockite rocks runs along the left bank from Solappadi to a point opposite Mettur on the right bank. Under the name "charnockite" is grouped a series of rocks in which the acid members are even-grained, granulitic hypersthene-bearing granites, and the basic members are rocks at one time known as "pyroxene-granulites". These rocks are characterized by their blue or brown-grey to dark-green colour, their sub-conchoidal fracture and by their fresh condition.

Detailed geology of the Sampalli sites.—A close examination of the surface between the northern and southern sites at Sampalli shows that the structure is not so simple as is shown on plate I. On the west of the Cauvery all the small foot-hills are composed of charnockites, whilst on the east the lower slopes of the southern of the two hills overlooking the river are composed of gneiss (see plate II). However, the space intervening between these two masses of charnockite rocks is not occupied wholly by the members of the gneissic system, for the knoll which lies a quarter of a mile to the north-north-east of Mettur village is charnockite (see plate II). Another small knoll stands by the west bank of the river and is east-south-east of Kallarampatti village; this also is charnockite. The strike of the charnockites of these knolls (as well as the strike of the gneisses) is in an almost north and south direction and they appeared to form a tongue intruded into the gneisses from the south.

An apparent outlier of charnockite to the east and a tongue intruded between it and the main mass made me look for some connecting occurrence of the charnockites. Careful search has shown that within the limits of the sites A-D neither tongue nor outlier is connected with the main mass of the charnockite hills.

On my return to Madras I was able to read, through the kindness of Colonel Ellis, Mr. Bruce-Foote's report on the geology of the Seccanur site (site E). On this point Mr. Bruce-Foote says:

"The band of massive charnockite of the right bank crosses the bed of the Cauvery diagonally some distance above the Seccanur site and rises into the hill ridge at Totylapatti, but a dam in that position would, as Mr. Moss pointed out, offer many fewer engineering advantages."

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* From unpublished manuscript by C. S. Middlemiss, Superintendent, Geological Survey of India.
† Memoirs, Geological Survey of India, Vol. XXVII, Part 2.

Since my journey to Sampalli, and the return also, was done in one day I had very little time to examine the road to the sites, and this connecting band escaped my notice, although before leaving the ground I had suspected its existence. The narrow band of the "mixed gneisses" which runs down the west bank of the Cauvery is composed, near site A, largely of mica and hornblende schists with only a small intermixture of gneisses, whilst as one proceeds further southwards the schists thin out and are replaced by gneisses. This has an important bearing on the selection of a site for the dam, for the schists easily disintegrate and this necessitates excavation to a considerable depth before solid rock is obtained. Gneisses are not so easily weathered and usually solid rock is fairly near to the surface. Charnockites are still less affected by weathering agents and will give solid foundations at a still smaller depth.

Site A (*Plates II and III*).—Along this site the first four pits were put down in the river-bed.

Pit No. 5 is in a 35-foot dolerite dyke in which the minerals have suffered decomposition. The rock will probably be quite fresh some few feet lower down. From pit 5 to the end of the site there is an alternation of rock-out crops and soil-covered stretches in which the pits have been put down.

The following is a brief resume of what is met with along the site :—

5-6.* Outcrop of fresh charnockite.

6. A biotite-hornblende gneiss.

6-7. A fresh charnockite.

7. A saussuritized gneiss, passing into a soft micaceous schist.

7-8. Fresh charnockite.

8. Saussuritized gneiss, passing into (8-9) a gneissose schist, with quartz veins which passes into (9) a micaceous quarts schist with thin stringers of charnockite.

9-10. Fresh charnockite.

10. Mica-schist with a pegmatite band.

10-11. Charnockite.

11. Mica-schist with a band of biotite pegmatite.

11-12, 12, 12-13. Tough fresh charnockite.

13. Mica-schist with stringers of charnockite.

13-14. Charnockite.

14. A saussuritized granite.

14 to the hills. Charnockite.

A "saussuritized" gneiss is one in which the original felspar has been broken up with formation of new minerals. The saussuritized gneisses of this Sampalli area are not quite of the normal type, in that there has been a considerable amount of recrystallization of quartz in the parts once occupied by felspar. This recrystallization has probably been caused by the heat of the charnockite intrusion.

These saussuritized gneisses when taken below the level of the surface weathering are found to be firm strong rocks.

Thus it is seen that the site crosses three types of rocks, the charnockites, the gneisses and the unsatisfactory schistose gneisses, and mica schists. The line crosses not less than sixteen junctions between dissimilar rocks.

Site B (*Plate II*).—Pits 3, 5, 6, 7, 8 are in charnockite with outcrops of charnockite between pits 5 and 6, 6 and 7, and 7 and 8.

Pit 8 is in the main charnockite mass of the foothills.

In pit 4 the rock is a schistose gneiss very much weathered with bands of more massive gneiss.

The line of site on the left bank has to cross a stretch of alluvium before it reaches the charnockite hill. Nothing is definitely known as to what is below this alluvium, but I presume that the junction between the gneisses of the river-bed and the charnockite of the hill must be under it.

Site C (*Plate II*).—This site was chosen and marked out the day before we left Sampalli and so specimens have been obtained only from three pits. They are—

From pit 2 at $10\frac{1}{2}$ feet—a decomposed gneiss.

pit 3 at 18 feet and pit 4 at 13 feet—charnockites.

The village of Kallarampatti is on charnockite, and that rock stretches continuously along the line of site to the westward.

Where the line of site abuts on the left bank of the river the hill is covered with small rock debris which obscures the junction between the gneisses and the charnockites. I estimate that the junction is not very much above the height of the river bank, in which case the dam will have to cross it, but at such a height as to cause no uneasiness.

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* 5-6 implies between pits 5 and 6 ; one number means in the pit itself.

Site D (*Plates II and IV*).—The specimens from the pits have been determined as—

Pit 1—is 23 feet deep and still in alluvium.
Pit 2—25 feet fresh charnockite.
Pits 3, 4, 5 and 6—in saussuritized gneiss.
Pit 7—is in an acid gneiss with local saussuritization.

To the west of pit 7 the main charnockite mass comes in. Some little distance down stream from site D and on the left bank is a 15-foot dolerite dyke which appears to strike across stream in a direction N. 35° W., and if continued to the right bank would pass between pit 1 and the bank. The dyke was only seen at the river edge and owing to periods of wetting and drying has developed, very highly, a set of joints which give rhombohedral pieces. However, the rock itself both at the edge and in the centre of the dyke is perfectly fresh and I have no doubt but that these joints will disappear at no great depth below the surface. I do not anticipate any trouble if the dam is to be built across this dyke.

The river-bed—Sites A to D.—At the time of my visit the river was in flood so that I had no opportunity of seeing the pits which had been sunk along the A and B sites. Specimens had been obtained from these pits but unfortunately, through the carelessness of the Overseer, they had been put into a bag without labelling.

An idea of the types of rocks in the river-bed can be gathered from these specimens, but of course questions of distribution cannot be settled.

The specimens have been determined as—

No. 1.—An acid charnockite, with lines showing crush structure. These are thoroughly recrystallized and should give no trouble.

Nos. 2 *and* 3—*Acid charnockites.*—They are fresh strong rocks eminently suitable for foundations.

Nos. 4 *and* 5—are apparently from an extremely acid band. They contain plagioclase felspar, microcline, quartz and very little ferro-magnesian mineral.

No. 6.—A saussuritized gneiss which is banded and gives signs of having been crushed. It is now thoroughly recrystallized and is a strong tough rock.

No. 7.—*Hornblende biotate gneiss.*—A fresh strong rock.

Mr. Stoney's specimens.—More definite information, although from a more restricted area, is obtained from the specimens collected by Mr. Stoney.*

Mr. Stoney sends eight specimens which have been labelled, and in addition more, of which he says: "The other specimens are from various places in the bed of the river between mile 27/6 and 27/7". These specimens have been handed over to me by Colonel Ellis and they have been determined as—

Nos. 1 †, 2, 3—are fresh strong acid charnockites.

No. 4—a fine grained biotite-epidote felspar rock, fresh and very tough.

No. 5—a saussuritized gneiss.

Nos. 6 *and* 7—dolerites, which are slightly altered, but will probably be quite fresh some little distance below the surface.

No. 8 †—an acid charnockite.

Of the remaining four specimens two are pieces of "Trap-shotten" gneiss, the third a good fresh charnockite and the fourth a saussuritized gneiss obviously from the same band as No. 5 of Mr. Stoney and No. 6 of the Overseer.

From the foregoing determinations it is evident that there is charnockite in the east bank of the river and a gneissose band a little to the west of it, with another band of charnockites somewhere in the bed of the river. Unless there are narrow bands of schists from which specimens have not been taken, there need be no anxiety about foundations in the bed of the river, for the specimens show the presence of fresh strong rock there.

Site E.—When returning from Sampalli to Bhavani I was requested by Colonel Ellis to look at this site.

From an examination of the pits and the materials obtained therefrom I am of opinion that good foundations will be obtained at a much less depth in the Sampalli C and D sites than in this one.

Site F, Main dam (*Plates V and VI*).—The western abutment of the dam line is the spur running from Urachimalai hill. The rocks of the hill are fresh tough hornblende gneiss and granetiferous-hornblende gneisses and are admirably suited for this work. They are followed to the east by hornblende schist. The junction is near to the Bhavani-Sampalli road and is at a point where the head of water is calculated to be about 100 feet. This is a weak place, for on the one hand are the firm very resistant gneisses and on the other hand the friable

* Report on the proposed site for the dam on the Cauvery near Sampalli by R. F. Stoney, Executive Engineer, dated 10th March 1909.

† The numbers are those used by Mr. Stoney in his report.

and less-resistant schists. Passing eastwards until within 300 yards of the eastern abutment the pits reveal nothing but a series of schists, which in places pass into more massive bands of gneiss. The eastern abutment is on low hills of acid granitoid gneiss in which occur irregular bands of a coarse pegmatoid gneiss with augen of large pink felspars.

Of the schists, one main type is a finely-foliated very friable biotite-quartz schist. This type occurs in pits 4, 5, 6 and 9. Although the rock is finely foliated, bands of more quartzitic material occur at frequent intervals and are of varying thickness. This is well shown in pit 9. These biotite schists pass into biotite gneisses which appear in the pits as solid bands which show jointing. These bands are not of great thickness (sometimes only one foot) as may be seen in pits 3, 4, 5, 6 and 9.

Another type of schist is the hornblende-quartz schist. This is a more compact rock than the biotite schist, does not show the same fissility and friability and is sufficiently compact to allow the development of joint planes. This type is met with in pits 3, 7, 8 and 14. Just as in the case of the biotite schists, the hornblende schists by an addition of felspar pass into hornblende gneisses which are met within narrow bands in pit 8. These schists are found much nearer the surface than the biotite schists and are fresher. There is one other type of rock intimately connected with the main schists and that is a biotite-hornblende schist which comes in an intermediate position. It is met with in pits 2 and 11.

Throughout these rocks there are numerous quartz veins, sometimes running with the foliation as in pits 1, 5 and 8 and sometimes obliquely to the foliation as in pits 6, 7 and 9. The maximum thickness of these veins is about 1′ 6″, but the usual width is 3″ to 9″.

In many of the pits in the schists there is a large amount of calcareous matter introduced in the form of veins and irregular stringers, which run along the lines of foliation across them at random and along the joint planes. The calcareous material is present as long as the rock shows the least sign of weathering. Pits 6, 8, 9 and 10 afford good examples of the above.

As one approaches the eastern end of the line, bands of gneiss and pegmatite are found to be intruded in the schists and several outcrops are to be seen on the surface.

In general the strike of the foliation of the rocks, as taken from the pits, is approximately north and south, that is, up and down stream. In pit 7 the foliation of the rocks is W. 20° S.-E. 20° N. with an inclination of 40° to N. 20° W., whereas in pit 6 the direction is E. 20° S.-W. 20° N. with an inclination to N. 20° E., and in pit 5 the direction is N. 35° E.-S. 35° W. with an inclination to the W. 35° N. There are no outcrops near, all is soil covered, so that it is almost impossible to say whether a fault or folding is the cause of this disturbance.

No pits have been put down in the river. However, I noticed outcrops of biotite schist on each bank just above water-level.

Subsidiary dam (*Plate V*).—In pits of the subsidiary dam all the rocks of the main dam are repeated and under similar conditions. In pits 15 and 16 where a 60-foot head of water would have to be held the rocks are very decomposed and deep foundations would be necessary. Between pits 16 and 17 is an outcrop of hornblende rock (amphibolite) and between pits 19 and 20 there is an outcrop of massive hornblende gneiss and schistose hornblende gneiss. As one proceeds along the line the rocks become less weathered and occur nearer to the surface, but this is in places where no big head of water is to be held and where the dam will be the nature of a bund.

Owing to the highly-developed schistose structure of the majority of the rocks along the line of the main dam and the easy passage which this structure gives to water, I fear that deep excavations will require to be made before unweathered rock is reached. When that is attained I do not think that trouble need be anticipated from joints as these, although incipient in the rock masses, are usually developed and widened by weathering agents.

Conclusions drawn—Urachikottai site (*F*).—The schists of this site, when fresh, are not tough and satisfactory rocks to build on. They occupy the centre of the dam, where the greatest head of water will be, and they are in the river-bed. They weather very easily and to considerable depths and they offer an easy passage for percolating waters.

By care, in excavating well into sound rock, the dam may be built in safety, but would probably not be an economical undertaking.

The schists in the river-bed strike down stream, that is at right angles to the dam. Special care would have to be taken to prevent percolation along these foliation planes with consequent enlargement and widening of them.

Sampalli sites, A, B, C, D.—From a geological point of view these sites are much superior to site F. Site A I discard at once because there is such a variety of rocks and a large number of junctions.

In sites B, C and D (premising that the rocks in the river-bed are of equal quality with those already described) I discard B because not only is the band of schistose gneisses inferior to the band of gneisses of C and D, but there is also an unknown stretch on the left bank.

Sites D I consider to be superior to C, for its gneisses are better in quality and are found much nearer the surface and are also fresher.

I therefore place the sites in order of their geological suitability as D, C, B, F, A and leave the final choice to be settled by further trenching, economic and engineering considerations.

Building materials for the Sampalli sites.—The charnockite foot hills to the south-west of Sampalli village will supply all the building stone which may be necessary. The most common stone is a medium-grained compact and very tough rock and is eminently suitable for a building stone in which strength is required. This stone has an average specific gravity of 2·77.

A finer-grained, darker coloured and more basic charnockite occurring as bands in the first mentioned rock has a specific gravity of 3·09.

Stability of the hill sides at the Sampalli sites.—The hills on to which the dam would abut do not show signs of being disturbed. The joints run approximately north and south and east and west. It will be necessary to remove several masses of large detached rocks from the region of the dam abutment and then I am of the opinion that there will be no trouble from rock slides.

Supply of lime at the Sampalli sites.—The alluvium in this area contains kunkar, sometimes scattered about in small nodules and sometimes in the form of beds.

In the neighbourhood of the sites there is a definite bed which occurs under the alluvium and forms a fringe to the river. In one small stream I found that the bed was at least 4 feet thick. It is not a hard crystalline kunkar but is earthy in character.

A fair sample taken from this bed gave, on analysis, 50 per cent of calcium carbonate. The residue was chiefly argillaceous matter.

There are no limestone deposits within reasonable reach of these sites.

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